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The Locomotive Steps Ahead

One of the striking facts brought out by Frank Russell in his paper on long locomotive runs, abstracted elsewhere in this issue, is the tremendous increase in the reliability of the steam locomotive. The locomotive of forty or fifty years ago no doubt justified the establishment of all engine districts on approximately a 100-mile basis. But since that time invention, better materials and refinement of design have been effecting a tremendous change in the locomotive, the full significance of which is only now being realized. Now, instead of being a machine of more or less uncertain ability to withstand more than a few hours of continuous service, its mechanical reliability and improved thermal efficiency have increased its capacity for continuous service beyond the possibility of its utilization in all but a few exceptional cases. While improvements in the locomotive itself will continue, the real problem now is the provision of new facilities for handling the locomotive and the realinement of others with which the locomotive coordinates in order that its potential capacity for service may be more fully utilized.

The Apprentice School

Few railroads have gone as far as the Atchison, Topeka & Santa Fe in the provisions they have made for the training of future shop mechanics. In the attention which it devotes to the intellectual training of its apprentices, indeed, it stands alone. Other roads have well developed schemes of shop training and a few give some attention to school room training at a few major shop points, but there is probably no other road in America that can show an apprentice school map which is comparable with that reproduced in an article on another page in this issue. It is not alone for the extent to which school rooms have been established that the Santa Fe apprentice system is notable. The work given these young men is extremely practical and comprehensive. Does this elaborate school system pay? Is it an investment in the future of the students, the return on which will accrue to them and not to the railroad? That the students themselves value the personal opportunity which the school courses offer is evident from the fact that the boys with better than average educational attainments are attracted to the Santa Fe apprenticeship and this in itself is an indirect advantage to the railroad. It is an unpleasant fact that railroad work has ceased to be as attractive relatively as it was a generation or more ago. This means that unless measures are taken to re-establish the old attractiveness, the whole tone of the railroad organization will inevitably have been lowered in another generation. The tone of an industry is determined by the character of the men in it. If the railroads find themselves compelled to fill their ranks from such recruits as are left after more attractive industries have taken their pick, the caliber of officers as well as of the men in the ranks will inevitably be lowered. So far as its mechanical department is concerned, the Santa Fe can face the future with confidence, both with respect to the ranks and the officers. Is not this ample justification for the cost of conducting apprentice schools? Can any railroad afford to do less?

Increasing Locomotive Productivity

The steam locomotive of the present day represents such a vast improvement over, and such a striking contrast to the locomotive of even so recent a time as 15 years ago, that the question arises daily as to what the next step in mechanical development may be. Heretofore unknown traffic demands have stimulated the efforts of locomotive designers and builders and much credit is due them for having developed a machine capable of the remarkable possibilities of some of the present types. But, while striving at all times to develop new types and to increase the efficiency of existing ones, mechanical men should not fail to consider the answer to this question, "Are we getting out of this machine all that it is capable of producing?" Any method by which the service hours and mileage of a locomotive can be increased is a means of increasing its productivity and one way of doing this that is being given consideration at the present time is the extension of locomotive runs. Elsewhere in this issue will be found an abstract of a paper presented at a meeting of the Pacific Railway Club by F. E. Russell, mechanical engineer of the Southern Pacific, in which this subject has been covered in a thorough manner that emphasizes not only the possibilities of increasing service mileage but also the problems that the mechanical man will have to solve in order to insure its ultimate success.

Selecting Men for Gang Foremen

Very careful consideration should be given in selecting a man to fill a position of responsibility. There are always, among a group of workmen, a few who stand out head and shoulder above the rest in the performance of their duties. These men should be considered available timber for promotion. Every characteristic and quality of these men should be carefully considered by the supervisory officers in selecting a man to fill a vacancy. He must be able to maintain the respect of the men who come under him. In order to do this he must thoroughly understand the work he is to supervise. He must be able to convey his knowledge of how to do a job quickly and surely to his men. A supervisor must have a certain amount of executive ability. As a general rule, every man under a foreman must be handled in a different way which requires a knowledge of human nature. The occasion will arise in any supervisor's career when his patience will be tried to the limit, and as a result, he may lose his temper. Such an occasion requires, on the part of a foreman, a display of unusual self-control in the presence of his men. He must be cheerful, loyal and efficient and must be able

to transmit these qualities to his men. The driving, arrogant, egotistical foreman is a figure of the past. The foreman of today must be able to gain the confidence of his men and educate them to the proper performance of their duties. He should be able to analyze the methods of doing things in his shop to see if he is using the best methods obtainable. He should be an exponent of fair and equal treatment, even-handed justice, mutual confidence and faithful performance of duty, with service cheerfully rendered. These points should be carefully considered in selecting men for higher supervisory offices and each time a vacancy is filled the utmost care should be exercised to the end that no injustice is done—either to the candidates for promotion, to the company or to the men to be supervised.

Prevent the Small Losses

When the general subject of fuel conservation is taken under consideration probably the last and least discussed fuel saving possibility is the power plant. It is true that only about 10 per cent of the fuel bill on the railroads is chargeable to power plant operation and in this fact may lie one of the reasons for the comparatively unimportant part the plant plays in the conservation program.

The average railroad power plant furnishing steam and compressed air to shops and engine terminals and possibly a nearby classification yard is a unit in the general scheme of operation that is more or less taken for granted. It rarely attracts much attention until some time when it fails to satisfy the power demand.

When the shop or engine terminal as a whole is laid out the power plant is designed to meet the existing requirements and a reserve factor added to care for possible operating emergencies or increased future demand. Within the plant itself the designing engineer will install modern equipment with fuel-saving devices and recording instruments by which the plant operation may be carefully checked and results compared. The plant operating engineer, by efficient supervision, may be able to produce from each pound of fuel the greatest possible power output in the form of steam or compressed air, but as a rule he has little control over the manner in which it is used.

The utilization of steam and air in shops and around engine terminals is a subject well worth looking into carefully, and, once a systematic investigation of conditions is inaugurated, one factor which will make an impression is the percentage of preventable losses due to waste from insufficient or improper insulation and from leakage, not to mention the injudicious use of steam and air in many places.

Make a tour of inspection of the shops, engine terminal and yards. Notice, for instance, the long outside pipe line or even the inside lines on which portions of the pipe covering has been destroyed and not replaced; leaking steam and air valves, enginehouse blower lines and joints, steam traps which do not function properly and pneumatic tools that have been laid aside after using without having had the air completely shut off. Look into the possibilities of improved methods for thawing out coal cars and locomotive ash pans instead of having the many open steam hose connections that are to be found around the coal pockets and cinder pits. Go out in the yards and note the air leaks around pneumatic switches and in the pipe lines that supply air for pumping up train lines.

There are many of these ordinarily unnoticed sources of loss that have a direct bearing on the coal pile and a serious effort should be made to locate and correct these conditions at this time of the year. The expenditure of a few dollars in repairs and improvements will be returned many times over during the winter months when the demands on the power plant are at the peak and, too often, difficult to meet.

Material Stocks at Engine Terminals

Serious consideration should be given to the installation and maintenance of working stocks of small materials at various points about engine terminals. If the men are properly educated to the advantages incurred by these facilities, considerable time and money can be saved in passing locomotives through the terminal. Stock bins should be located at the inspection pits containing material which can be used to make light repairs on the driving gear, valve motion, air brake equipment and underneath the locomotive. The inspectors would then have to report only the defects which they were unable to repair and the repairmen at the enginehouse or the outbound track would devote all their time to making the heavier repairs. Stock bins located at the outbound tracks should contain metallic packing of various sizes, knuckle pin collar plates, brake shoes, certain complete units of air brake equipment and any other parts which can be applied to a locomotive without sending it to the enginehouse. Engine terminal delays can often be avoided by having these small repair parts conveniently available when an engineman wants some minor repairs made before he leaves the terminal. Stock bins located at these two points will enable repairs to be made to many locomotives without sending them into the enginehouse, thus reducing congestion and enabling the enginehouse foreman to direct the efforts of his men in the enginehouse on those locomotives receiving boilerwash attention or in for more serious defects. Here again the stock sections can be used to advantage. They must be located at proper intervals about the enginehouse taking into consideration the work performed by the various crafts. These bins need not contain large repair parts, as the main storehouse is usually convenient to the enginehouse. They may, however, contain a full supply of nuts and bolts of all kinds and sizes, washers, split keys, cotter pins, and other small parts which are regularly used. The initial expenditure of building the bins or shelves in which the material may be kept will soon be made up by the time and money saved in eliminating the trips to the storehouse for material which these bins contain. A stock section may well be kept for the boilermakers, containing various sizes of staybolts, crownbolts, copper ferrules and caps. The success of these working stocks depends on how well they are kept up and on the degree to which the men are educated to support and use them.

Time Lost at Engine Terminals

The lack of equipment at engine terminals, poor track layout and arrangement of facilities, or in some cases, lack of organization, cause a heavy loss of time. Man hours are lost. Locomotive hours are lost. An intensive study of present engine terminal conditions and operation is now under way by the locomotive utilization committee recently appointed by President Aishton of the American Railway Association, because it is recognized that almost no other factor has a more important bearing on the effective use of locomotives than the conditions at terminals where they are turned and prepared for service.

What are some of the points where man hours, and consequently locomotive hours, are lost? The coaling station and cinder pit are frequent offenders, especially when labor-saving facilities at these points are inadequate. Within the enginehouse, time is lost by the mechanics in covering the circle to locate engines, discover the defects and get the necessary tools and material together to do the work. There is delay in reporting deficiencies either in material, tools or reports. In some cases the supervision is compelled to spend entirely too much time making out reports *after* the work has been done and the engine returned to service. Such post mortem statements are of value as records but should not be allowed to

interfere with the real job of enginehouse foremen and gang leaders, which is supervision.

Improper heating and ventilation make it physically impossible for men to do their best work and while perhaps the normal enginehouse will never be 100 per cent in this respect, the provision of smoke jacks of the proper type, keeping windows clean, blowing off locomotives into a hot-water washout system and keeping the temperature in the enginehouse within a reasonable distance of 60 deg. F. will do much to improve present conditions. In view of the great improvement in recent years in power crane trucks for handling heavy locomotive parts at terminals no enginehouse foreman should be expected to get results without an adequate number of these trucks and the smooth, substantial floor required for their efficient operation. Many of the places where time is lost at engine terminals were pointed out by E. Gelzer, mechanical engineer of the Chicago Great Western, in an article in the February issue of the *Railway Mechanical Engineer*. The intensely practical analysis of enginehouse delays made in this article, together with suggestions for their improvement, make the article well worth re-reading.

Another matter of importance is the method of firing up locomotives at terminals. Many methods have been tried. Enginehouse foremen should keep constantly in touch with what other roads are doing and not be satisfied with their present method simply because it is the one which has been used for years. One railroad has recently demonstrated important savings by kindling fires with a fuel oil torch applied directly to a three or four-inch bed of coal spread evenly over the grates. This method replaced the former method of kindling with scrap wood. It was found that there was no essential difference in the time of the two methods, but the saving in labor cost of cutting up and handling the wood far offset the cost of the fuel oil used with the latter method. Enginehouse men have an important opportunity to affect favorably the cost of railroad operation by studying constantly present terminal operation and putting into effect the plans necessary for their improvement.

New Books

UNITED STATES SAFETY APPLIANCES. *A practical manual by H. S. Brautigam, formerly assistant to the master car builder, Chicago, Milwaukee & St. Paul. 232 pages, 3¾ in. by 6 in., illustrated, bound in manila. Published by the Simmons-Boardman Publishing Company, New York. Price* $1.00.

This book is a practical manual of the safety appliance laws, legal decisions rendered in cases arising under them, and Interstate Commerce Commission orders and interpretations covering the application of safety appliances to the motive power and rolling stock of steam railways in the United States. In its preparation, the author has drawn on a wide experience in dealing with the many questions arising in carrying out the provisions of the safety appliance regulations. In order to facilitate reference to the material, it has been divided into ten parts. Part I contains the text of the original Safety Appliance Act, the amendments and supplements thereto and the Ash Pan Act. Part II contains the orders of the Interstate Commerce Commission and the circular of the Master Car Builders' Association relative to the stencilling of cars. Parts III to VI contain the text of the government specifications for the several classes of equipment covered by the enforcing order of the commission, each part devoted to one class. A particularly valuable feature of these sections will be found in the explanatory comments that have been interspersed at numerous points in the text which suggest preferred practices where the text is open to more than a single interpretation. In Parts VII and VIII will be found rules for safety appliances on electric locomotives and on gas, electric and gasoline motor cars, respectively. These classes of equipment are not specifically covered in the order of the commission and, hence, these sections are not official requirements. They are, however, specifications which have been used and found in actual practice to meet the requirements of the law as interpreted by the inspectors of the Bureau of Safety. A very convenient feature of the book is contained in Part IX. This is the official classification of defects to be reported by government inspectors, accompanied by box car and caboose drawings, on which are shown the defect numbers in their proper locations. Reference to the drawings shows at a glance the numbers of all reportable defects and, by referring to the list, the nature of these defects may readily be determined. In Part X have been grouped general rules and definitions applying to all classes of equipment. Some of these rules are included in the various orders of the commission. Others are rulings which have been made in specific cases where doubt or dispute has arisen as to the intent of the law or the interpretation of the commission's orders. Special memoranda of a similar nature applying to specific classes of equipment are also included at the end of the section dealing with the rules for that particular class of equipment.

The illustrations include the official drawings of the Bureau of Safety specifications, and also numerous sketches illustrating alternative types of construction or applications which have been found to meet the requirements in a number of the cases in which questions have most frequently arisen. The book is of convenient pocket size and will prove to be a most useful volume to all who have to deal directly with the inspection or checking of safety appliances on steam railroad equipment.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION, YEAR BOOK, 1923. *232 pages including advertising, 5½ in. by 8½ in., bound in paper. Published by the Association, Chicago.*

This book contains a complete transcript of the proceedings of the eleventh annual convention held by the American Railway Tool Foremen's Association at the Hotel Sherman, Chicago, August 29, 30 and 31, 1923. The year book contains a presentation of the proceedings in which will be found several exceptionally interesting articles on the subject of machine tool operation and the reclamation of shop tools and equipment. There are also papers on jigs and fixtures, combination punches and dies and tool grinding, all of which are well illustrated. While the year book will no doubt be of greatest interest to tool-room foremen, there are, nevertheless, many valuable suggestions which shop foremen in general will find it well worth while to give careful consideration.

THE CALCO HANDBOOK OF RECUPERATION—*Compiled by G. D. Mantle, Engineer, The Calorizing Company, Pittsburgh, Pa., loose-leaf, 160 pages, 8½ in. by 11 in. Published by the Calorizing Company, Pittsburgh, Pa. Price* $3.00.

This hand book, which is designed to aid in the improvement of industrial furnace practice, presents the application of the principles of combustion and recuperation in such a concise and readable manner that the publication can hardly fail to appeal to the railroad mechanical man who is directly concerned with the operation of shop furnace equipment. The text is divided into 13 sections which cover thoroughly the principles of combustion, a discussion of the principles, advantages and possibilities of improvement of combustion by recuperation as well as the theory of design and practical application of equipment utilized in the calorizing process. Thirty full page illustrations, 30 illustrations in the text, 63 full page charts, 11 charts in the text and five pages of tables supplement the text in a way that enables the reader to grasp the important facts immediately.

What Our Readers Think

Courtesy for Good Measure

CLEVELAND, Ohio.

TO THE EDITOR:

I recently heard a lecture to the apprentice class of the Santa Fe railroad at Topeka, Kansas, into which the speaker interjected the following compliment to the railroads:

He said the policy of the Santa Fe could be compared to that of the old-time milkman, who, after having given the customer full measure of good milk, would dip his long-handled ladle again into the big can and bring up just a little more which he would add to the already fair measure. This extra was called a "tilly."

"It is so," the speaker said, "with the Santa Fe and other up-to-date railroads of the present day. They all aim to give full measure of good service, and then a little more, as a 'tilly.'

"And that 'tilly' is courtesy." READER.

One Cause of Rod Failures

COUNCIL BLUFFS, Iowa.

TO THE EDITOR:

When rods fail, as they sometimes do, it is the usual procedure to ascribe it to one of two causes—defective material or abnormal stresses. Certainly these two causes are most plausible and the first to occur to the mind of an investigator. Nevertheless, there are many instances of failure where it would be difficult to prove that one or the other of these factors is the primary contributing cause. Breaks usually occur under conditions of speed and operation such that the damage immediately following the break is very likely to obliterate the evidence.

If rods are of correct design, fabricated from proper material, with the quality of workmanship that such an important piece of machinery deserves, then they should fail only by reason of abnormal stress. Correct design is not easily attained. The stresses under normal working conditions are difficult to determine with accuracy and those of abnormal conditions are hardly to be guessed at. Design must therefore be empirical to a degree and adhere closely to good and conservative past practice. In the matter of materials, steels having highly desirable characteristics are readily available. It is therefore decidedly false economy not to utilize them.

Correct design and the best available material, alone, will not produce the desired results. There is the matter of workmanship. Unquestionably inferior workmanship is the largest contributing cause of breakage. Stresses can only be kept down near normal by having all the work which affects the service of the rod properly and conscientiously done. Quartering of wheels must be exact; tramming likewise. Shoe and wedge adjustments must maintain it. Rods must be exactly trammed when laid out, and finally the actual machining and finishing of the rod must be carefully done. Assuming that wheels are correctly quartered and in tram—for if this work is not properly done no rod will stand up—let us look at the machining of the rods, particularly the finish. Rods should be finished all over, not only planed or milled. Milling is the most desirable method, but the rod should actually be finished by filing and polishing with abrasive cloth to a reasonably good finish, particularly on the part of the rod that is subjected to the greatest bending stress.

It is well known that rods are subjected to both lateral and vertical bending stresses. There is also alternate tension and compression. Machine parts in which combined stresses and reversal of stress occur encounter the severest duty to which machinery can be subjected. Failures naturally occur at the point of greatest stress or at some point where the structure is weakened by a slight flaw, nick or tool mark. A failure must always have a starting point. The sensible thing is to avoid such starting points by eliminating all tool marks and taking care that rods are handled in such a way that they are not nicked or scored.

In research work, machines have been developed to produce what are known as fatigue tests. Their purpose is to concentrate into a few hours or days the actual wear and tear which would be caused by years of ordinary service, the object being to determine how many applications of a known stress are required to bring about failure.

Suppose we have such a machine that will duplicate, on a reduced scale, the stresses occurring in a main rod. Prepare two specimens for test, making them alike from the same material and giving them the same degree of finish. Take one of these test specimens and score it lightly with a scriber, somewhere in the zone of maximum stress, leaving the other as finished. It will almost inevitably be found that the scored specimen will fail much sooner and at the point where scored.

Well finished and polished rods are further desirable in that they can be very easily inspected and incipient failures detected. They may very easily be kept in good condition and appearance by occasional wiping with oily waste. It goes without saying that they should never be painted. Painting will serve only to hide defects that might otherwise be apparent at a casual glance. THOMAS E. STUART.

Old Ideas with New Life

TO THE EDITOR:

A well-known manufacturer of pneumatic tools and machinery recently placed on the market a new type of air valve for general service, which contains several new and valuable features of interest to railways and other users of compressed air. It is a well-known fact that the action of compressed air on valve seats, gaskets and packing of ordinary globe valves is very destructive, and the rapid wear of these parts, resulting in leakage and loss of air in transmission, causes excessive maintenance costs throughout the plant and a great waste of fuel. The high pressures used with modern equipment have increased the losses from these sources, and it was with a view of reducing or eliminating these losses that the new valve was designed.

This valve is of the hollow tapered plug type, in which the air pressure on the large end of the valve plug is utilized to hold the plug on its seat, without the air coming in contact with the seat. The necessity for frequent replacement of plug and seat is thereby eliminated, and, by eliminating also the necessity for packing, stems, gaskets and springs, the number of parts required is reduced to a minimum.

Severe tests of this valve under pressures as high as 500 lb. per sq. in. have demonstrated its ability to withstand successfully the most exacting conditions encountered in modern compressed air service. It is interesting to note, however, that the hollow tapered plug valve, pressure seated, was used in a combination sandblower and brake attachment for locomotives, and patents were granted about twenty years ago.

This is one of many interesting examples of valuable ideas which were partially developed years ago, without their true value being recognized at the time, and were allowed to remain in obscurity when they might have been rendering valuable service. In many similar cases it has remained for the present-day railway shop or railway supply company to develop these ideas to the point where they are adapted to present-day conditions. HOWARD G. HILL.

Railroads — accounting

Railroads

Cost Control for the Mechanical Department

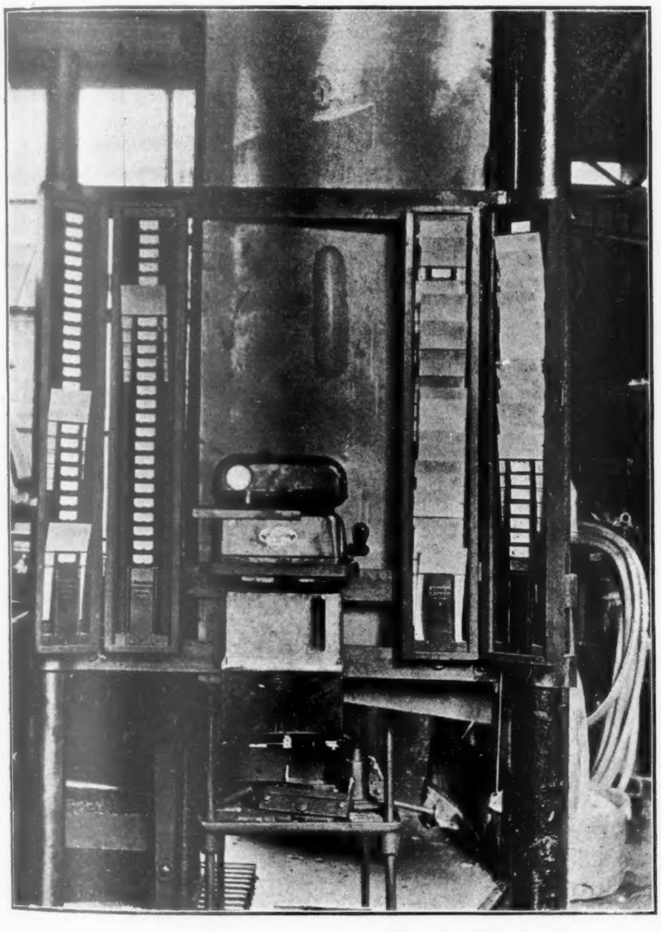
Cost Knowledge and Production Control Bring About an Improvement in Railroad Operating Costs

(Cost accounting)

By George W. Armstrong,
Special Representative, Mechanical Dept., Erie Railroad

CONTROL of industrial operation requires a clear perspective of its countless activities. Effective control requires more, it calls for a digested knowledge of the details and the intricacies of those activities; a knowledge as to the ratio of returns to expenditures to protect the business against the wastes which cannot otherwise be detected.

Railroad accounting is clearly defined by the Interstate Commerce Commission regulations. This uniform classification of accounting serves the purpose for which it was designed. It furnishes, indeed, statistical data of the most valuable kind for the railroad executive in charge of the property, for the investor and for the regulating commissions. But the reports of railroad operation as a whole fail to throw light on the details of its productive activities.



Arrangement of Time Cards and Clock Which Are Used for the Proper Distribution of Labor Charges

Cost accounting is concerned with the details of these primary accounts in railroad operation. One of its prime functions is to enable the executive in immediate charge to know currently the details of what is going on in his plant. Records of cost by themselves cannot effect economy, it is only by their proper presentation in convenient and convincing form to the executive responsible, that he is put in a position to correct the inefficiencies revealed by these records, through improvements in organization, administration and in individual processes and methods. The degree of refinement in a cost accounting system should not exceed that required to secure this result; i.e., effective control. The essentials of any cost keeping system are that it accurately account for materials and supplies purchased and given out; that it charge labor to the work on which it is employed; that it furnish an accurate check and distribution of overhead expense or burden; that it record facts and conditions and provide for current interpretation of their significance.

Responsibility for Cost Accounting

Cost accounting to be of the most value in accomplishing the purposes of production control should be a part of the general scheme of a production organization. It is not accounting, but interpretation of accounts; it is the indicator of individual effort and output. Effective production when and as wanted is secured by a well devised scheduling and routing system. The aid and effective use of cost accounting to control and stimulate production insures that schedules are met and a full return is obtained for money invested.

The full benefit of a cost accounting system depends on a liberal and sympathetic attitude on the part of the accounting department as to its application and operation permitting the basic distribution to be made by the mechanical department as an integral part of its production organization, thus following the plan most effective in the industrial world. The payroll and material disbursements in total become the controlling accounts of which the accounting department look to the cost accounting department for full detailed explanation. Also the records of the cost accounting department are and must be subject to periodical audit and check on the part of the accounting department as far as their interests are involved.

Cost accounting as relates to maintenance of equipment, divides sharply into three branches:

First.—Accounting for the cost of general repairs to equipment units.
Second.—Accounting for cost of finishing parts for equipment repairs prior to shopping of the equipment unit or in quantity for storehouse stock.
Third.—Accounting for maintenance repairs in conjunction with operation; i. e., engine house and cripple track repairs.

General Locomotive Repair Shops

The requirements for cost accounting in a locomotive repair shop are a sub-divided classification of expenditures to the locomotive undergoing repairs, and a shop order system to care for finishing parts in quantity or in advance of the need and of such unusual expenditures as initial superheater application, valve gear, etc.

What is cost accounting to accomplish in connection with general repairs to the locomotive? Is it to secure a record of the exact cost of each shop operation or to furnish an aid to production and a means of determining whether an adequate return is secured for value expended? Obtaining a complete distribution of the time consumed by each workman on each operation will not solve the cost problem, but will result, the more complete and elaborate such distribution is, in getting further from the desired end. The only effect will be a tremendous volume of detailed information practi-

cally impossible of digestion. Grouped charges for individual locomotives backed by complete details entering into these group totals will, however, supply the means for analyzing cost differences, between shops, the individual engines in a class, the differently designed details of various classes of engines and the classes as a whole.

Indicator for Constructive Analysis

For constructive analysis in directing operation in controlling and determining policies based on cost accounting facts and in finding whether a proper equivalent is secured for money expended, labor and material should be charged to master classifications of work by key reference and locomotive number. A standard key, using a memonic reference, i.e., one by its letter combinations suggesting the thing for which it stands, should be established. Such a classification follows:

COST ACCOUNTING CLASSIFICATION FOR LOCOMOTIVE WORK

AB	Air brake work....	Includes overhauling and applying air pumps, brake valves, governors and all air brake equipment, except piping and foundation brake rigging.
AP	Ash pans	Includes hoppers, door operating mechanism and all work new or old including application.
BA	Brick arch	Includes overhauling and applying brick arch and tubes.
BL	Boiler	Includes all work on shell of boiler, smoke box, exclusive of front end arrangement and smoke box front. Does not include fire box or flues. Does include new front flue sheet.
BR	Brake rigging	Includes overhauling and applying foundation brake rigging for freight engine truck and locomotive, but not tender brake rigging which is included in tender trucks.
CB	Cabs	Includes all work in connection with overhauling cabs and running boards.
CF	Cab fittings	Includes overhauling, etc., all cab fittings, injectors, lubricators, etc.
CG	Cylinder and guides...	Includes all work in connection with cylinders, bolting, bushing, cylinder heads and guides. Does not include steam pipes, valves, pistons, piston rods or crossheads.
DB	Driving boxes	Includes all work in connection with driving boxes, shoes and wedges and cellars.
DG	Draft gear	Includes front end coupler, drawbar, draw castings on locomotives and tender and rear end coupler, also uncoupling mechanism, end sills, pilot beam and pilot.
EH	Electric headlight	Includes repairing electric headlight, turbine, generator and applying headlight and wiring classification lamps and cab lights.
ET	Engine trucks	Includes all work in connection with two and four wheel engine trucks, including center castings and springs but does not include brake rigging.
FB	Fire box	Includes removing and applying staybolts, patching, repairing or applying new parts to fire box, including outside sheets and back flue sheets.
FE	Front end	Includes repairing and applying front end arrangement, smoke box front and door.
FL	Flues	Includes repairing and applying flues.
FR	Frames	Includes all work on main frames, frame braces, pedestal jaws and binders. Does not include trailer and engine truck frames.
GR	Grates	Includes repairing and applying grates and grate rigging.
PA	Painting	Includes all painting, surfacing and lettering of locomotive and tender.
PG	Power reverse gear...	Includes all work in connection with power reverse gear, except piping.
PJ	Pipe and jacket work..	Includes all piping on locomotive and tender jacket repairs and application and lagging boiler and fire box.
PN	Pistons, piston rods and crosshead	Includes pistons, piston rods, packing rings, packing, crossheads and gibs.
RD	Rods	Includes all work in connection with main and side rods, including application.
SP	Steam pipes	Includes throttle, throttle rigging, dry pipe, steam pipes, exhaust pot and nozzle and steam pipe casing.
SR	Spring rigging	Includes spring rigging complete, except engine truck and tender trucks.
ST	Stoker	Includes stoker engine, distributors, conveyors, and other work, except piping.
SU	Superheater	Includes header, damper, cylinder and superheater units.
TF	Tender frame	Includes underframe and flooring. Does not include draft gear
TK	Tank	Includes everything in connection with cistern and coal space excepting stoker conveyor trough.
TT	Trailer trucks	Includes all work on trailer except springs and foundation brake rigging if any.
TET	Tender trucks	Includes all work on tender truck, including spring rigging and brake rigging.
WH	Wheels	Includes all work on driving wheels and axles, including crank pins, counterbalance and wheel hub liners.
VE	Valves	Includes all work in repairing and applying valves, includes bushings for piston valves, steam chests and valve chamber heads.
VG	Valve gear	Includes repairing, applying and setting valve gear.

Provision should be made for checking labor distribution directly in the department and without requiring the foreman or workman to perform any clerical labor in its allocation. The foundation of the value of cost accounting depends upon the accuracy of its elements and this demands proper allocation of charges. Material orders should be issued by one or more men delegated primarily for that duty, thus insuring proper distribution as well as a check on the disbursement of material.

Shop Overhead Accounting

Overhead should be accounted for and distributed as far as possible by departments, a separate shop expense account being kept for each department. Effective control is insured by definitely fixing these indirect expenses along departmental lines, establishing individual responsibility and giving the department executive a means of telling whether his costs are high or low. It also serves to reflect a truer cost on parts manufactured on shop order in quantity or otherwise, with a heavy indirect departmental labor charge and possibly a low direct labor cost.

General expense of the shop such as supervision, building repairs, etc., impossible to allocate by departments, as well as depreciation of shop buildings, machinery and power plant, insurance, taxes and other general accounts (for which provision should be made to take up a proportionate share at the local point) should be pro-rated, first on the basis of the total labor payroll chargeable to Account 308—Maintenance of Equipment, Repairs to Steam Locomotives—as distinct from labor payroll to shop orders. Then to properly reflect the condition in relation to each locomotive undergoing repairs and to serve as a just charge against a locomotive held unduly, the account 308 proportion of this general expense should be allocated on the basis of the erecting shop hours the locomotives have spent in the shop.

The aim of overhead accounting should be to reflect accurately the conditions so apt to be overlooked and which so insidiously sap the earnings by increasing maintenance of equipment expenses. The component parts of overhead as commonly taken up at the local point are all within the control of the local management.

When for any purpose it becomes necessary to ascertain the real competitive costs of effecting repairs or making locomotive and car parts in quantities, it is only a comparatively simple task to reconstruct the accounts for application of an additional percentage to take up the following items carried in general accounts. These items are not necessary for regular consideration in effecting the desired end of production control through cost knowledge. These overhead expenses are:

Pay of shop superintendent or master mechanic, account 301.
Wages of shop clerks to shop superintendent or master mechanic and expenses of shop superintendent or master mechanic, account 301.
Cost of labor and material for repairs to shop machinery, account 302.
Cost of repairing power plant machinery and apparatus, account 304.
Stationery and printing, account 334.
Injuries to persons, account 332.
Repairs to shops and engine houses, account 235.
Repairs to power plant buildings.
Insurance, taxes, interest on valuation, depreciation, proportion of general expenses.

Shop Order System

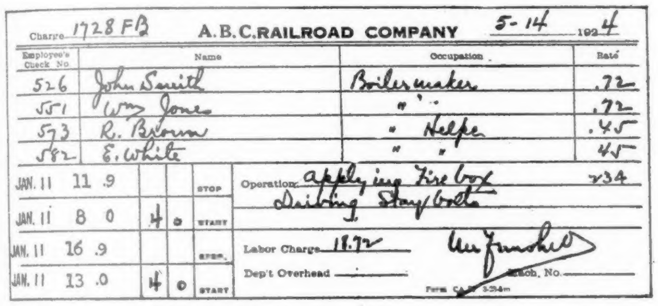
Shop orders should be used for all materials manufactured in quantities, prepared in advance of the shopping of the equipment unit, or finished for outside shops, and to allocate expense for certain improvements chargeable to capital account or for other purposes where it is necessary to segregate the charge definitely. Such shop orders should be keyed to denote the month of issue. This is denoted by the ten-thousand group in which the number occurs, thus 10,067 is a shop order issued in January; 30,152, a March shop order, and so on. Shop orders, as issued should not only designate clearly and definitely what is to be accomplished (no blanket orders allowed) but also the departments upon which it is

issued. The cost accounting bureau should be supplied by the stores department with a copy and no charges should be accepted from any department not listed on the shop order without further authorization.

To permit the following of work and to record progress, a shop order credit slip should be required from the receiving department or storehouse for each transfer and turned in by the originating or sending department to the shop order clerk.

Engine House Operation

Proper determination of running repair costs is virtually impossible under a system of workman time allocation. A workman is not a bookkeeper and the inevitable tendency is to charge the time distribution to the engines in sight at the time of making out such distribution or to take the first



Time Card Showing Distribution of Labor Charged to a Fire Box

things coming to mind, whether they represent engines worked on that day or out on the road in service.

A cost system for an engine house, to secure effective control, does not necessitate the degree of refinement demanded for general repairs. Sufficient detail to judge the efficiency of the terminal itself, to afford some basis for comparison between terminals and serve for analysis and equating of facilities, and further to permit of comparative costs as between classes of engines will suffice. Cost statistics of such nature will then permit of analysis as to the comparative maintenance costs of different designs of equipment, between different specialties and appliances and in many ways be productive of benefit in shaping policies for improved operating economies.

The foregoing essentials can be accomplished by, as far as possible, allocating direct labor by classes of locomotives and to a more condensed work classification than that employed in the shop, although using the same symbols. The prefix *R* should be added to denote roundhouse. Such a classification is as follows:

REPAIRS TO EQUIPMENT

RAB	Air brake work
RBL	Boiler
RBA	Brick arches
RCG	Cylinders
RCF	Cab work
RFE	Front ends
RFL	Flues
RFR	Frames
RRD	Rods
RSR	Spring rigging
RSU	Superheater
RST	Stoker
RTK	Tender
RVE	Valves
RVG	Valve gears
RWH	Wheels

HANDLING ENGINES

AH	Loading or shoveling ashes
BF	Flues cleaned
BP	Packing boxes
BW	Boiler washing
CO	Coaling
DP	Dispatching
FC	Fire cleaning
HS	Hostling
IN	Inspection
PF	Preparing fires
TE	Turning engines
TI	Supplying engines with oil and waste and tool inspection
WE	Wiping engines

Car Repairs

The same general scheme and the same essential need for a cost accounting system applies to the car department. The classification of work charges for passenger and freight car repairs should cover the same detail. However, there is one essential difference as between charges for general repairs to cars and running repairs, in that the former are allocated by individual car units and work classifications, while the latter are allocated in bulk to the work classification only, with one further distinction in the case of freight car repairs, distributed as between home and foreign cars. The following classification is suggestive.

FREIGHT CAR CLASSIFICATION

TK	Trucks
DG	Draft gear
UF	Underframe
BK	Brakes
HCS	House car superstructure
OTS	Open top car superstructure
RG	Roofing
PA	Painting

PASSENGER CAR CLASSIFICATION

PTK	Trucks
PDG	Draft gear
PUF	Underframe
PBK	Brakes
ST	Superstructure
SE	Seats
PF	Platforms
PPA	Painting
PRG	Roofing

While the foregoing method will serve many useful purposes in analyzing where costs of car repairs go, as between different important subdivisions of the car and in certain classes of cars as far as general repairs are concerned, it does not fill all requirements for analyzing freight car costs. Freight cars spend a large portion of their service life on other railroads than the owning one. Analysis of A.R.A. bills will of course give the balance of the story. But here again we are confronted with our old bugbear of impossibility of digesting a mass of details, and the different basis upon which foreign and home costs are necessarily determined. Consequently the suggestion outlined recently by Laurence Richardson deserves careful consideration. This is in brief to designate say 50 in a series of 1,000 cars by a "dummy" private car line, and have all repairs to them, home or foreign, billed in accordance with the A.R.A. billing practice. These cars would be treated on the owning road as foreign cars, as far as charging for repairs are concerned, but with the understanding that in extent of repairs they are to be treated as home cars. Then by employing the group classifications outlined above as well as the car series totals; thorough analysis will show many things with respect to comparative designs of similar car details as well as relative merits of different car designs.

Method of Labor Distribution

A job time card should be utilized for purposes of securing labor distribution. These job cards should preferably be issued by men especially designated for that purpose located at proper and convenient points throughout the shop. These men become in effect assistant foremen, relieving the foremen of all clerical work and giving them more time to supervise and direct the workmen. These cost timekeepers should consequently be practical men and should be viewed as eligible timber for future foremen.

A thorough scheduling system should go hand in hand with a cost accounting system. The cost timekeeper, cooperating with the foreman, should prepare in advance job tickets for each workman to eliminate delays and also to insure meeting the schedule. These job tickets should be racked up by the cost timekeeper so that workmen can obtain new jobs. The time of starting and stopping jobs is marked on the job ticket either by means of an electrically controlled cost recorder or by the foreman or cost timekeeper.

A job time card should be made out for each job worked upon, or for each day's work. By job is meant the unit for which charge is to be found—such, for example, as fitting up a set of side rods for a certain engine, applying a firebox, or making 1,000 set screws on a shop order. Operations like sensitive drilling, threading miscellaneous bolts or other work obviously of small time increment applicable to any specific charge should be treated as departmental overhead.

Where jobs are originated in departments other than those

in which they are to be performed, a job card should be made out by the foreman ordering the work, filled out with the proper charge and instructions as to the operation to be performed and forwarded with the work as authority and instruction for performance.

Operation description on the job time card should be brief, but in sufficient detail to define the work. Where a job is not finished within one day's period, an unfinished job card must be turned in for each day's work.

With the installation of a cost accounting system, if not already in use, should be used a time clock system for checking workmen in and out. The weekly or bi-weekly time clock card, then becomes the instrument for determining payroll earnings, while the job time cards become the distribution of these payroll earnings.

Material Orders

All materials, except nuts, washers, cotter pins, grate pins, split keys and similar materials uniformly used in the car shop, should be ordered on proper material orders. The excepted articles should be carried as a working stock in the department and charged out in the overhead expense of that department. Material orders should be made out by the foreman or cost timekeeper and made by proper engine number and group number, shop order or overhead designation. Each order should be confined to material of one store department class and one charge. Material orders after being priced and extended by the store department will be turned over to the cost accounting bureau for distribution.

Overhead Accounting

Overhead will be divided into two classes as far as shop operation is concerned—departmental and general. These two classifications are as they indicate, those which can be allocated or assigned to a respective department, and those assigned to the shop as a whole.

Shop Expense

General

Shop watchmen
Small tools
Shop tool attendants
Shop switch engine crew
Handling ashes power plant
Stationary firemen and engineer
Unloading coal at the power plant
Shop crane operator
Shop janitor
Cleaning soot
Cleaning shop yard
Whitewashing
Time clock system
Belt repairman
Check clerk
Employment clerk
Distribution clerks
Report clerk
Portion wages passenger in shop superintendent's office
Shop order clerk
Shop messenger
Yard laborers
General foreman
Power } Until basis established
Heating } for departmental
Lighting } distribution
Traveling expenses
Removal snow and ice

Departmental

Lye house, labor and material
Small tools
Cleaning shop
Building fires in blacksmith shop
R. H. tool room attendant
Oiling machinery
Departmental crane operators
Cleaning machinery
Washing windows
Cleaning shop pits
Checking in and out
Departmental laborers
Departmental foremen
Fuel for forges
Working stock material

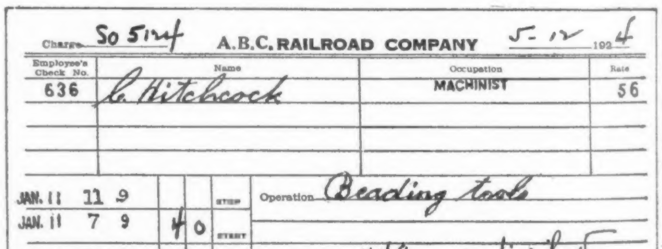
The Interstate Commerce Commission classification of accounts requires that overhead represented by shop expense shall be distributed in the relative proportion which the total amount of charges to shop expenses bears to the total of the directly distributed labor. Owing to the fact that manifestly power, portion of interest, depreciation and repairs to building, etc., applicable to a large slab milling machine or planer are greater than that for an 18-in. engine lathe or drill press; this is obviously not a wholly equitable method of distribution. The effect of this requirement can, however, be to a certain extent offset, inasmuch as it is applicable for primary account distribution and not essentially concerned with the detailed items entering into the primary accounts. Thus the distribution of overhead in a manufacturing department, after its proportion of the whole is determined, can be made on a floor space proportion basis or on any other which would reflect the difference in operating cost of an engine lathe, automatic machine or large turret lathe.

Following in the main, however, the I. C. C. requirement, departmental overheads are to be distributed on the basis of the job labor cost to the total labor charges. General overhead expense is to be distributed on basis of the proportion of erecting shop days during the month to the total erecting shop days.

Cost Distribution

Each day the job time cards for the preceding day will be figured for elapsed time, extended and check to see whether they are complete for each department and agree in total hours with those shown on the in-and-out cards.

After completing extension and check, they will be sorted by job charges and by means of a Dalton listing adding machine, job costs and the balance struck. This is done on a sheet, 8½ in. x 11 in., arranging the figures in columns and leaving a suitable binding margin on the left hand edge. Between each column is left space for recording each group charge, shop order charge, etc., when checking. The daily


Charge SO 5124 A.B.C. RAILROAD COMPANY 5-12 1924

Employee's Check No.	Name	Occupation	Rate
636	C. Hitchcock	MACHINIST	56

JAN. 11	11 .9			STOP
JAN. 11	7 9	4	0	START
JAN. 11	16 .9			STOP
JAN. 11	13 .0	4	0	START

Operation Beading tools

Labor Charge 448 unfinished

Dep't Overhead

Mach. No.

Form CA 21—9-23-5m

Machinist's Daily Time Card Showing Labor Charge Credited to a Shop Order

sheets obtained thus become a record of the distributed charges and furnish a quick means of ascertaining cumulative charges to any job. Material charges after they are received from the storekeeper will be distributed by jobs and groups in the same manner as labor charges.

Where the volume of work is sufficient to warrant, the punch card system should be employed and electric sorting and tabulating machines utilized to make the necessary distribution and balance. This point in general will be where the volume of work is such that a reduction of $125 per month or more could be effected by the use of such machines.

Cost of Cost Accounting

One of the uppermost thoughts in the executive's mind is "What will cost accounting, or production control, cost?" One answer is, no more than piecework directly, but far less indirectly. A more concrete and comprehensive estimate, however, is given in the following tables:

Locomotive Shop

	No. of workmen	No. of cost men
Blacksmith shop	38	1
Boiler shop	95	2
Carpenter and tank	21	1
Tin pipe and copper, electrician and paint	38	1
Machine, fitting and erecting shop	229	4
Miscellaneous mechanics	25	..
Laborers	64	..
	510	9

In addition, a night force of about 60 to be handled by a foreman, through use of the Stromberg cost recorders.

9 cost booth men at $175 per month		$1,575
3 distribution clerks at $110 per month		330
1 cost accountant		250
		$2,155
Average monthly payroll	$63,000	
Average monthly material charges	54,000	
	$117,000	
Percentage of cost control on monthly charges		1.84

Car Shop

	Foremen	Mechanics	Helpers	Laborers	Total	Cost men
Passenger dept	3	25	5	4	47	1
Paint	2	20	9	..	31	1
Pipe and tin	1	10	..	..	11	1
Upholstery	1	5	1	1	8 }	1
Planing mill	1	6	1	2	10 }	
Machine	1	10	5	1	17 }	1
Blacksmith	1	16	16	1	34 }	
Freight repairs	5	70	4	2	81	2
Steel car repr	2	54	4	3	63	2

Miscellaneous force:	Foremen	No. of men	Total
Laborers	1	24	25
Storeroom	..	27	27
Scrap yard	2	29	31
Watchmen	..	3	3
Firemen	..	2	2
Engineer	..	1	1

Total cost force:		
9 cost booth men at $175 per month		$1,575
3 material men, checking material after application to car prior to painting at $175 per month		525
3 distribution clerks at $110 per month		330
1 cost accountant at $250 per month*		250
		$2,680
Average monthly material charge	$58,500	
Average monthly payroll	77,000	
	$135,500	
Percentage of cost control on monthly charges		1.975

Freight Car Repairs

Assign 1,000 cars to represent 20,000 cars. Assume charges upon A.R.A. bills to average one Hollerith card per day. This requires punching, tabulating and analyzing 1,000 cards per day.

Force

1 analyst at $4,000 per year	$4,000
1 Hollerith punch operator	1,200
Rent of sorting and tabulating machines	1,200
	$6,400

Assume the average cost of repairs per car per day as $160. The amount represented by cost of repairs to freight cars for 20,000 is $3,200,000 and the cost control cost as a percentage of the repair costs, amounts to 0.2.

What Cost Accounting Accomplishes

The results to be obtained from cost accounting will depend on the spirit in which it is undertaken and the co-operation secured from the employees, depending on how effectively it is sold to them. Then too, it will be governed by the actual condition existing in a shop prior to its undertaking. But, unquestionably, in any shop it will afford a more uniform production and point out many otherwise overlooked and undiscovered leaks and possibilities for improvement. A few examples will possibly serve to illustrate.

The cost of cylinder packing rings were observed in one shop to take a sudden jump. Investigation following the cost accounting indications showed the increase largely due to a change in practice, cutting off five rings instead of four at one time. This resulted in getting 15 rings in place of 16 per casting. For a total material cost of $359.10, 135 rings instead of a possible 144 were secured, or a cost of $2.66 per ring instead of $2.49. The actual labor cost per ring was 23.3 cents. The direct labor represented only 8.8 per cent of direct material. Disregarding shop and store expense, labor cost could be increased 73 per cent without entailing any greater increase than the reduction in the number of rings per casting caused in material costs. Two alternatives were presented, either restoring the former practice or modifying the casting to be cut up into 15 rings with a minimum of waste. Had this been undiscovered it could have continued as a constant leak.

Another road discovered after the installation of a cost accounting system, that the painting costs for freight cars seemed high. An analysis of the situation disclosed that owing to the use of small capacity containers for the spray painting, too frequent trips were required to the paint shop for replenishing the supply. With the installation of large capacity tanks, wheeled to the painting zone, a marked reduction in painting expense was effected.

Another road's interesting application of cost accounting, as a production control device, has been the checking of daily output with experience performance tables that had been developed. By means of these experience tables the individual efficiency or department efficiency can be readily ascertained. It has been found that this gives a very effective control over uniformity of output, permits of quickly locating the erratic worker and also cases where production time is unduly increased owing to fixtures, tools, etc., made for efficient production being unused due to need for repair or through ignorance of their existence on the part of a new workman.

Conclusion

An insurance premium of 2 per cent for cost accounting or production control will add about ½ per cent to the burden of maintaining equipment proportion to operating expense. But cost knowledge and production control which can come through such cost accounting and cost analysis should be one of the most important agencies in constructively aiding to bring about an improvement, a substantial reduction in these railroad operating costs. An awakened cost consciousness on the part of the management is the one great hope for bettered operation, for that awakening will lead straight and inevitably to improved facilities, organization and equipment.

Bronze Tablets Are Awarded as Prizes for Efficiency in the Locomotive and Car Departments of the C. M. & St. P.

Extension of Locomotive Runs*

A Discussion of the Advantages of Long Runs and the Mechanical Difficulties Encountered

By Frank E. Russell
Mechanical Engineer, Southern Pacific

WE have read and heard more about long locomotive runs during very recent times than in past years, and as our ideas and thoughts are governed largely by comparisons, what would have been considered a long run two generations ago would be termed a very short run these days.

Shortly after the first steam locomotive was actually put in operation some of the enthusiasts, in discussing and writing about the possibilities of the new machine, became so visionary as to predict that at some day in the future the machine might be so perfected as to travel at the unprecedented speed of a mile a minute. On the other hand, there were many wise men of that day and age who contended it would be impossible for a human being to live traveling at that rate of speed, and furthermore, claimed that it would be impossible to build a machine would could run faster than 12 or 15 miles per hour and hold up under that service.

The development of the steam locomotive has kept pace with the development of civilization, for during a period of about 100 years the steam locomotive has developed from a crude miniature machine, capable of little more than self-propulsion and running not over 15 miles, to a huge, efficient machine capable of handling smoothly and easily luxurious passenger trains consisting of 12 cars weighing 875 tons over mountain, desert and plain at high speed for a distance of 815 miles. The existence of the locomotive corresponds to three generations and its development follows very closely the development of railroading which can also be divided into three characteristic periods, the period of railroad construction, the period of expansion and rule-of-thumb methods and the period of improvement in materials used and application of mathematical talent in computing stresses and proportioning parts.

The locomotives placed in service up to the year 1864 were of crude construction and wrought iron was the principal material used. They were not equipped with power brakes or any of the modern devices.

During the next period, 1864 to 1894, the principal changes in locomotives in this country were generally an increase in size, application of air brakes, automatic couplers, injectors and other appliances and the use of steel in construction.

During the period 1894 up to the present time we find new materials used and much improvement in design, also many new devices developed, not only increasing the power output and durability, but also very materially producing more economy and a higher efficiency. The most important of these devices are superheaters, feed water heaters, brick arches, boosters, improved valve gears, and improvements in air brakes and lubricators, all of which have a marked effect upon the distance over which the locomotive can be successfully operated.

Effect of Topography of the Country

There are many conditions which determine how a locomotive can be economically operated. The first and most important of these is the topography of the country which determines the gradient and curvature, making it necessary to change power to suit the grade conditions.

The location of shop facilities is to a great extent controlled by the character of the country and operating conditions. In most cases these facilities were established many years ago when roads were built to suit the power and equipment then in use, and there is no question but that a great many locomotive runs could be extended more or less if we could easily move the shop facilities to take care of the power. This, however, would mean an expenditure of huge sums of money which could be used to better advantage for other purposes.

Under present day conditions, when terminals and repair facilities have already been located, it requires considerable courage on the part of the motive power and operating officers to extend locomotive runs, especially as they cannot readily increase the runs, say 10, 20 or 30 per cent, but must take a bold step and double or treble the distance. Thus, in referring to long locomotive runs, they are generally considered to be such only when locomotives are regularly operated over two or more districts where the power formerly was changed. The mere fact that locomotives may be successfully operated over an unusually long distance may not necessarily mean the most economical operation. The most important object in extending the length of locomotive runs is to increase their productive time, or in other words, obtain greater monthly mileage from the power.

Terminal Time Non-Productive

The time locomotives are at terminals, in engine houses, etc., is non-productive time. Taking the Class I railroads in the United States during 1921, the average non-productive time of freight locomotives amounted to somewhat more than

*Abstract of a paper presented before the Pacific Railway Club.

TABLE I—SOME OF THE LONG LOCOMOTIVE RUNS MADE ON AMERICAN RAILROADS

Passenger Service

Road	From	To	Miles
Southern Pacific	Los Angeles, Cal	El Paso, Tex	815
M. K. T.	Parsons, Kan	San Antonio, Tex	678
Union Pacific	Kansas City, Kan	Denver, Colo.	640
Southern Pacific	Sparks, Nev.	Ogden, Utah	536
A. T. & S. F.	Winslow, Ariz.	Los Angeles, Cal	602
Union Pacific	Council Bluffs, Ia	Cheyenne, Wyo.	509
Union Pacific	Council Bluffs, Ia	Denver, Colo.	562
Union Pacific	Denver, Colo.	Ogden, Utah	577
Canadian National	Montreal, Que.	Toronto, Ont.	334
C. M. & St. P.	Milwaukee, Wis.	Minneapolis, Minn	321
Great Northern	St. Paul, Minn	Minot, N. D	526
Great Northern	St. Paul, Minn	Winnipeg, Man.	458
Missouri Pacific	Hoisington, Kan.	Pueblo, Colo.	338
St. L. & S. F.	Oklahoma City, Okla	St. Louis, Mo	542
Kansas City Southern	Pittsburgh, Kan.	Shreveport, La.	430

Freight Service

Road	From	To	Miles
Southern Pacific	Sparks, Nev.	Carlin, Nev.	387
Southern Pacific	Del Rio, Tex	El Paso, Tex	453
A. T. & S. F.	Los Angeles, Cal	Needles, Cal.	310
Union Pacific	Ellis, Kan.	Denver, Colo.	337
Canadian Pacific	Calgary, Alberta	Edmonton, Alta.	180
St. L. S. F.	Memphis, Tenn.	Birmingham, Ala	251
M. K. T.	Parsons, Kan.	Denison, Tex.	278
Union Pacific	Kansas City, Kan	Ellis, Kan.	303
Grand Trunk	Ft. Erie, Ont	Sarnia, Ont.	189
C. M. & St. P.	Chicago	Mahaut, Ia.	209
Great Northern	Havre, Mont.	Wolf Pt., Mont	202
I. & G. N.	San Antonio, Tex	Palestine, Tex.	260
B. & O.	Cumberland, Md.	Parkersburg, W. Va.	205
B. & O.	Connellsville, Pa.	Willard, Ohio	264
B. & O.	Willard, Ohio	Chicago	278

17 hours out of the 24; hence, the locomotives were idle and not earning two-thirds of the time. In fact, during this time they are not only non-productive, but are actually costing the railroads considerable sums of money for attention and fuel in keeping them hot and otherwise taking care of them at terminals.

The average monthly mileage of freight locomotives in active service on all classes of railroads during the year 1921 was only about 2,400 miles, and for passenger locomotives, only 4,100 miles. Hence, it will be seen that there is ample opportunity for improvement by obtaining greater mileage out of locomotives, which is equivalent to increasing the number of locomotives in service.

Many railroads are cognizant to these advantages, as is revealed by the number of railroads increasing the length of locomotive runs. In Table I several of the more striking examples of long runs in freight and passenger service have been listed and show the remarkable progress that has been made in this phase of operation.

Modern Appliances Facilitate Long Runs

Modern appliances such as the superheater, feedwater heater, brick arch and the booster have contributed to the possibility of running locomotives over greater distances than have heretofore been considered feasible. The effect of the superheater is virtually to increase the boiler capacity. A locomotive equipped with superheater can perform approximately the same work and the boiler only evaporate two-thirds as much water as a saturated steam locomotive. This in turn is equivalent to increasing tank capacity and reduces the amount of scale-forming matter deposited in the boilers over a given run. It also produces increased power at high speed and permits of operating the locomotive at a shorter cut-off. In addition to this, the superheater very largely overcomes carrying water over into the cylinders, which washes off lubricants, and causes lubrication trouble.

The feedwater heater helps to make long continuous runs successful by diverting a portion of the exhaust steam, which would otherwise be wasted, to the boiler in the form of water. This amounts to about 10 per cent, thus making it possible to go somewhat further before taking water and reducing the amount of impurities admitted to the boiler. In addition, as the heat is returned to the boiler there is a saving in fuel, as well as an increase in boiler capacity. In diverting a portion of the exhaust steam to heat feedwater, a reduction is made in back pressure in the cylinders, which in turn increases the power output of the locomotive by probably 2.5 per cent to 5 per cent. A modern locomotive equipped with a superheater and feedwater heater should be able to handle the same train for possibly a 50 per cent greater distance without evaporating any additional water in the boiler. However, such devices, when locomotives are idle, standing at terminals, on sidings, etc., are not making these savings; hence, the importance of keeping them in use.

Brick arches and other improvements in fireboxes and boilers have also done much to increase boiler capacity, fuel economy and reliability.

The booster in many cases will provide the locomotive with sufficient additional power to carry it over some controlling grade on the line, thus fitting it to the service and permitting its operation over a longer run than would otherwise be possible without the use of helpers. The use of boosters in starting heavy trains on grades or slippery rail will usually prevent drivers slipping and spinning, which sets up severe strains in machinery and undoubtedly produces more wear than many miles of actual running.

Effect of Refinement in Design and Materials

Refinement in design and materials of construction has made it possible to build locomotives with ample boiler capacity, sufficient strength of parts and adequate bearing areas, and still keep within the weight limitations. Much has also been accomplished in recent years by improving engine trucks, trailings trucks and spring and equalizing systems, relieving the locomotive of unnecessary shocks and vibrations. Vibration is probably the greatest single cause of failure and regularly exacts its toll of every piece of machinery in operation. One of the most important improvements in recent years that materially reduces shocks and vibrations has been accomplished by utilizing higher grade materials in conjunction with improved design in such parts as connecting rods, crossheads, piston rods, and pistons. The side rods and a portion of the main rod are revolving parts, and the others, such as front end of main rod, crossheads, pistons and piston rods, are reciprocating parts. The reduction in weight of both revolving and reciprocating parts materially reduces the wear on rod brasses and pins. The reduction in weight of reciprocating parts is one of prime importance for we know there is no other single feature that will cause more vibration and set up more destructive strains than counter-balance, either the lack of it or too much of it. The revolving parts we can balance in all directions as both the parts to be balanced and the counterbalance have a rotary motion. With reciprocating parts it is different; they have a horizontal motion and the balance placed in wheel centers to balance them has a rotary motion; hence all weight placed in wheel centers to balance these parts is over balance in a vertical direction and produces a disturbing force on rail. With heavy reciprocating parts in common use 20 years ago, it was necessary to balance two-thirds of the weight of these parts. Reducing the weight of reciprocating parts to less than 1/160 of the weight of locomotive permits balancing only 50 per cent.

Weight of reciprocating parts, to one not familiar with the design and operation of locomotives, might appear somewhat insignificant. It is, however, of prime importance in making the locomotive a more efficient and durable machine.

Advantages of Long Runs

The advantages and economy of running locomotives over two or more divisions when topography of country and operating conditions permit, are as follows:

First—Increased mileage. I have yet to learn of a single case where extending locomotive runs has not resulted in increased mileage over a period of time. However, increasing length of run 100 per cent does not necessarily mean an increase in locomotive mileage of 100 per cent but it does usually range from about 30 per cent to approximately 100 per cent, depending on operating conditions, or, in other words, how the runs fit in with train schedules.

Second—Reduction in number of locomotives required. An increase in locomotive mileage is equivalent to a corresponding increase of locomotives, and as shown by the extension of runs by the Southern Pacific between Sparks and Ogden, the same 15 locomotives made 68 per cent more mileage per month after they were run through, which enabled them to do the same work as 25 locomotives operating over the old runs.

Third—Increased railroad capacity. The railroads of the country today are handling heavier traffic than at any time in their history. They are being hampered on all sides by legislative committees, which makes it very difficult to finance new facilities and equipment; hence the importance of getting the most out of what we have.

Reduction in work for locomotives at small outlaying terminals permits reducing the number of expensive tools required at such points, where they are used only a portion of the time and permits assembling them at main terminals where they can be utilized to greater advantage, thus reducing the investment in these facilities.

Fourth—Economy at Terminals. Locomotives running over two or more divisions do not require at the intermediate

points the attention of wipers, hostlers, ash-pit and coal-dock men, machinists, boiler inspectors, etc. The cost of turning a locomotive after it has made two or more divisions is very little, if any, more than if similar attention had been given at intermediate points, and repairs can be made in a more substantial and workmanlike manner as there is ample time and facilities to take care of them.

Fifth—Saving in fuel. During the year 1921 about one-fifth of all locomotive coal used, or 25,000,000 tons, was consumed when the locomotive was not doing useful work.

Waste of fuel on account of dumping coal fires, and rebuilding fires as well as fuel for keeping locomotives hot is saved, which amounts to a considerable sum. An eastern road reports cost of dispatchment about $12.00 and that at a particular point, on account of running through, the dispatchments were reduced by 28 per day, thus making a saving of $336 per day or approximately $10,000 per month from this cause alone. The amount of fuel required to keep locomotives hot and prevent freezing at outlaying points, in cold climates is a big item. The amount of coal lost in dumping and rebuilding fires is estimated at from one to two tons per locomotive dispatched, and with coal at from $3.50 to $5.00 per ton, this represents an item of importance in the reduction of expenses.

On lines using oil this saving is not experienced, but they do enjoy the saving on account of not having to keep engines hot at intermediate points. At one point alone, in cold climate, this has been estimated at $15,000 per annum.

Possible Disadvantages

Now, let us consider the possible disadvantages, increased cost of maintenance and increase in engine failures. Maintenance is also a factor to be considered in connection with long locomotive runs, since an increase in the daily mileage of motive power and a reduction in the time held at roundhouses would presumably affect the condition of locomotives. For this reason particular inquiry has been made in regard to the average mileage between shoppings of locomotives operated on long runs and it appears where records are available the mileage made by these locomotives between shoppings is as high, if not higher than when run over short runs.

It would appear reasonable that we should get as much if not more mileage out of a locomotive if run off in, say, two years time than in three or four, as we know time and the elements collect their toll whether a locomotive is in operation or not. Also, it is a question if the cooling down and firing up strains in a locomotive do not do more damage than fair service.

In the case cited of the long run on the Southern Pacific between Sparks, Nevada, and Ogden, Utah, since the locomotives went into service they ran off 47,691 miles in ordinary service at the rate of 5,299 miles per month, and up to December 31, 1923, had run off 213,380 miles in long runs, averaging 8,891 miles per month. This makes an average total mileage of 261,000 miles up to January 1, 1924, and will probably average about 300,000 miles before locomotives go into shops for general repairs, which is certainly not discouraging for long runs.

The question of possible increase in locomotive failures has been watched by those interested in long runs and it appears that such failures apparently are not affected by the mileage which the locomotive makes during its individual run. Analysis of failures shows that the majority take place on the first division and that the mileage of the individual runs has little or no effect upon the number of failures experienced.

Locomotives Need Careful Attention

Special attention and care are necessary in making long runs successful. Much depends on the care exercised on the part of engine crew, inspectors and shop forces. A locomotive offered for service must be in good condition, which means that all details requiring attention have received that attention and where repairs are made, that they be of a permanent and not of a temporary nature. This latter practice frequently occurs on ordinary runs, in order to get locomotives back to the main terminal. Then, oftentimes, on arrival at main terminal the men are especially busy, or think they are, and "Let her go for another trip."

Enginemen should report on blanks provided for that purpose all parts that are not working properly or that in their judgment require attention. This is especially necessary where crews are changed, so the proper attention can be given on arrival at terminal.

Lubrication is especially important and the engineman should give particular attention to this; also, shop forces should see that all parts will lubricate properly.

On coal burning roads it is important that the fireman keep his fire in proper condition up to the time he is relieved, so that the fireman taking the locomotive will not be put to undue difficulty.

By building up long runs gradually and supervising closely, these items of lubrication, work reports and fire conditions may be eliminated and no more trouble experienced with them than on shorter runs.

Main Objective

After all is said and done, the consideration of prime importance is, not so much the attainment of the longest possible locomotive runs, as it is to obtain the greatest mileage per unit of time per locomotive owned, with the smallest fuel consumption, and the least expenditure for repairs and enginehouse attention. This can best be done by designing equipment to fit the special service requirements, providing boilers of ample capacity, and applying standard devices that will increase the efficiency and reduce fuel consumption. Particular attention should be given to the design of various details, using high quality material in parts where reduction of weight will minimize the stresses set up in machinery and in track and roadbed. Select the softest natural feedwaters available, and chemically treat those that contain objectionable impurities, reducing these impurities to a minimum, and provide hot water boiler washing facilities at terminals to reduce cooling down strains in the boiler and save fuel.

Discussion

One of the questions which arose during the discussion of Mr. Russell's paper was, "What disposition is made of the reports when one engineman is turning over his engine to another?" One road handles this matter by having the incoming engineman make out his work report, attach his signature and turn one copy over to the outgoing engineman. Another copy is given to the enginehouse foreman or master mechanic at the point where the turnover is made. In this manner one copy of the report stays with the locomotive to the end of the run and a copy is left at the intermediate repair point as a record in connection with government inspection. Another road has issued instructions that the incoming engineman will make his report, place it in a pocket in the cab and the enginemen handling the train over the succeeding operating districts fill in the additional work they may wish to report and, after having attached their signatures to that part of the report made out by them, leave it for the engineman getting off at the final terminal to turn the reports in. It was conceded, however, that the particular manner of handling reports should, in all cases, satisfy the requirements of government inspection.

An interesting point brought out in the discussion was the fact that the majority of the failures which occur on long runs over two or more divisions happen, as a rule, on

the first or second division out of the starting terminal. One road reported that it has been found possible to overcome delays due to minor defects by adding supervision, both on the road and at terminals, and by the analysis of each defect with the idea of correcting the underlying causes immediately. The general conclusion seemed to indicate that ordinary failures occur from improper attention or lack of attention at terminals and that the solution can be brought about by complete co-operation between locomotive crews and enginehouse forces so that necessary work will be promptly and completely reported and repairs made in a permanent manner.

Apprenticeship Methods on the Santa Fe*

Written (3)

It Has Been Found Necessary and Profitable to Provide Highly Specialized School Room Instruction

Part III

Railroads - Employees - Training

THE course of training given Santa Fe apprentices is composed of two co-ordinate branches—that given the apprentices by the shop instructors while they are at work in the shop and that given by the school instructors in the apprentice school rooms, established and equipped for this very purpose. So long as mind is considered above matter, so long will education and development of the mind be considered an essential part of any worthwhile training system.

Apprentices at Work in School Room

Public Schools Do Not Furnish Specific Instruction

The public schools should not be expected to provide the specific instruction or training needed in all varied occupations of life. It will be sufficient if they give the general education needed in all walks of life and lay the foundation upon which may be based the specific education needed for each particular activity. It is becoming more and more evident that the specific instruction needed in any occupation, and particularly in that of an industrial vocation, must be provided by each corporation according to its specific needs.

It is well known that the majority of boys everywhere, particularly those entering industry—and this includes those entering upon apprenticeships in railway shops—have not taken and cannot be made to take full advantage of the opportunities offered in the public schools. United States government statistics show that only 2 per cent of all pupils entering school receive a college education, only 14 percent ever finish high school and only 34 per cent, or one out of three, even complete the work of the common schools.

The unusual opportunities offered apprentices on the Santa Fe have attracted applicants of much more than the average education. The majority have completed the common schools and have had some high school work; many

*This is the third of a series of four articles on the apprenticeship system of the Atchison, Topeka & Sante Fe. The concluding article in our next issue will discuss matters of general interest in connection with the apprenticeship system, such as the apprentice boards, instructors' conventions, records maintained, tools furnished, moral training and discipline of apprentices, apprentice clubs, special apprentices, recruiting of instructors, promoted graduates, by-products and direct results derived from the apprentice training system.

are high school graduates. But on most railroads and in most manufacturing plants, the majority of boys entering upon apprenticeships have not attended high school or even completed the work of the common schools. Whether their failure to profit by the education offered in the common schools is due to their own neglect or to unavoidable obstacles, real or imaginary, is immaterial. The fact remains and is indisputable that the majority of boys old enough to enter any industry do not and cannot be made to go to school. The only solution left is to bring the school to them.

Continuation or Part-Time Schools

The public continuation or part-time schools, where similar groups of boys alternate each week, one group working in the shop and the other going to school and vice versa the following week, or where boys are released from the shop (generally on pay) to attend public school one day or a half-day each week, are efforts to meet this situation, but at best they have their limitations. Corporations everywhere are realizing that the only satisfactory solution of the problem is the shop school, established and maintained and conducted by the corporation itself.

These corporation schools are free from outside entanglements and from objectionable and worn out traditions of the public schools, can be managed and conducted by the corporation itself and, best of all, can be made applicable to the specific needs of the corporation giving the training. They have a twofold aim: first, that of correcting the defects or omissions in the previous schooling of these young men regardless of their cause; and, second, that of giving them the schooling needed in their particular line of work.

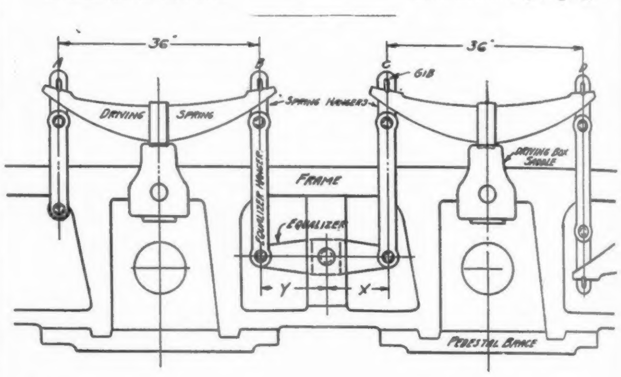
Models Used in Teaching Mechanical Drawing

Apprentice Schools on the Santa Fe

With this end in view the apprentice schools on the Santa Fe were inaugurated at the same time the apprentice shop training system was established nearly 17 years ago. They have since been maintained continuously with ever-increasing efficiency. The purpose of these schools is to develop the brain and increase the mentality and reasoning faculties of each of these apprentices and to equip him with that knowledge of his trade and of the subjects relating to the trade which can best be taught by the company itself on company property away from the noise and dirt of the shop, but sufficiently near for convenient accessibility. In brief, the apprentice is taught to use his brain as well as his hands. He is made familiar with the company's standards and methods, its aims and policies, and a feeling of loyalty to the road is kindled and maintained, which is akin to that of the college man for his alma mater.

This school instruction is given on the shop property in rooms provided and equipped for this purpose. The cost of erecting and maintaining these school rooms, of heating, lighting and ventilating them, of supplying the cabinets, the tables, the desks and the lesson sheets, necessary drawing instruments, paper, pencils and all other school room supplies, also that of the salary of apprentice instructors, is borne by the railway company. Moreover the apprentices are paid for the time attending school, the rate of pay being the same as that paid them for time worked in the shops.

SANTA FE SYSTEM
APPRENTICE SCHOOLS — **MATHEMATICS, Page 65**



Main — **Back Intermediate**

Spring Rigging

512 What will be the pressure on the top of the main driving box, if a weight of 13,000 lbs. is pulling down on the end of the driving spring at A, and 13,200 lbs. on the other end at B?

513. On a locomotive, Class 900, the weight applied at the equalizer pin is 26,500 lbs. How many pounds are being applied to the hanger at each end of the equalizer if dimension X is 11 in and Y 12 in.? What will be the weight on each hanger if X is 11 in. and Y 11½ in.?

514. Why is it necessary to have dimensions X and Y on equalizer of different lengths?

515. On a certain locomotive having spring rigging arranged as shown in Fig. above, the main driving wheels are found to be carrying too much weight. Which way should the equalizer pin be moved in order to relieve the main wheels of this excess weight? Why?

516. If the weight applied on the equalizer pin on a certain locomotive is 26,500 lbs., where should the center pin hole of the equalizer be located in order to place 200 lbs. more on the hanger C than B? The end holes on equalizer are 22½ in. part.

An Example of the Practical Setting Given to Mathematical Problems

Apprentices Required to Attend School

The apprentices are required to apply themselves diligently and urged to take full advantage of the opportunities offered. They are subject to the same discipline in the school as in the shop. All regular apprentices are required to attend school a total of 208 hours each year, that is, two two-hour periods each week. Absence from school with or without permission is treated in the same manner as similar absence from shop duties. The apprentice is given permission to be absent on special occasions but such permission must be obtained in advance and all absence from school must be made up so that each attends school a total of 208 hours each year. No difficulty whatever is experienced in securing 100 percent attendance. The apprentices appreciate the opportunities offered and strive to make the most of them, their interest increasing as they advance in their apprenticeship. Not infrequently apprentices ask permission to attend school on their own time in addition to the required assignment.

When schools were first established classes were held during working hours, generally from 7 a. m. to 9 a. m. and from 1 p. m. to 3 p. m. Apprentices were assigned to such classes as would least interfere with the work of the shop. For instance, if six apprentices were working on lathes, two would go to school on Monday and Thursday, two on Tuesday and Friday, and two on Wednesday and Saturday. Since the inauguration of the eight-hour day the classes have been held outside of working hours, the majority going to school immediately upon leaving the shop, the others returning to school after supper. In assigning the apprentices to classes before or after supper, consideration is given the apprentices' own wishes and to the distance they live from the shop. So far as possible each is permitted to select the evenings and classes he wishes to attend. Apprentices are treated fairly but firmly. They must be regular in attendance at school and must apply themselves diligently.

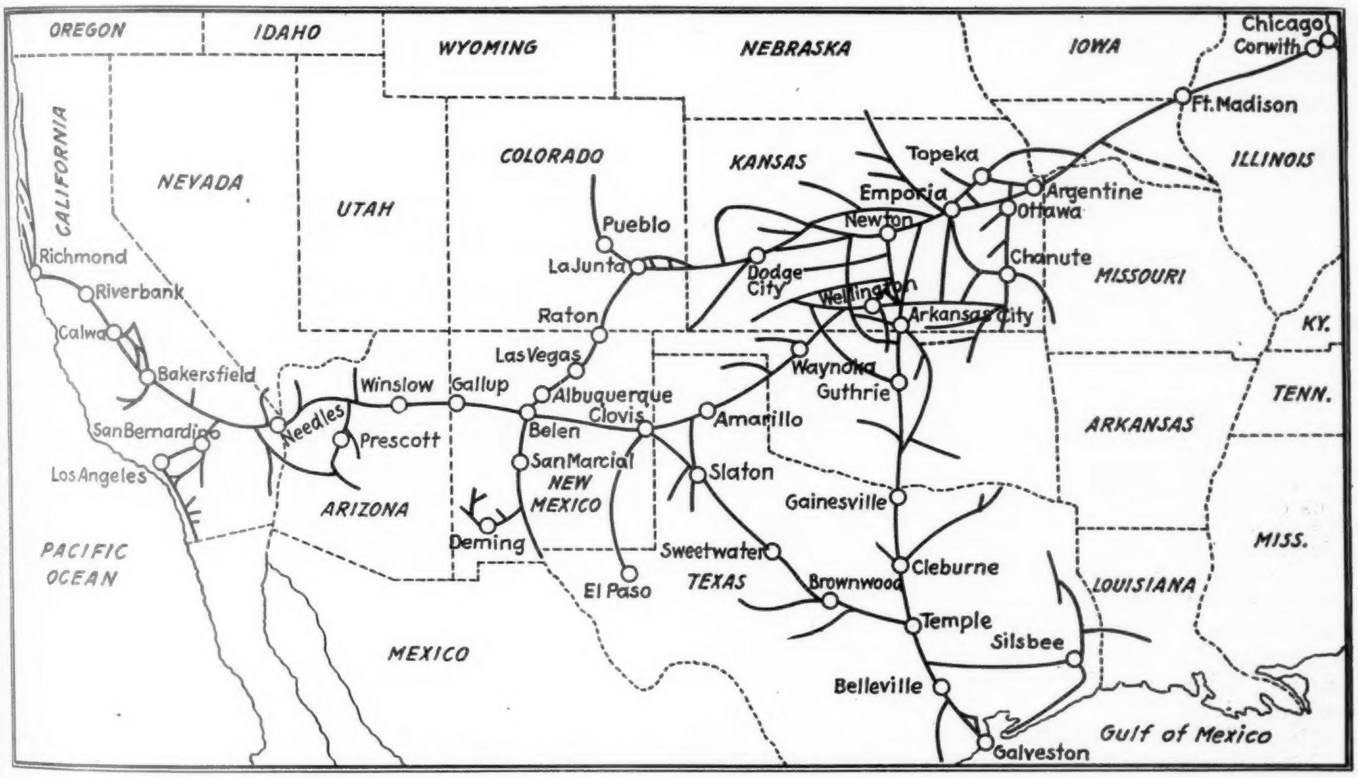
Previous Education of Applicants

The apprentice courses of the Santa Fe have proved so attractive that the average education of beginners is doubtless much higher than that of those entering railway service on most roads. Many have had a high school education or at least a year or two of high school work, but some were compelled to leave school before completing even all the work of the common schools. However, even those who have completed all the work offered in the public schools are not sufficiently prepared for the work of their trade. Much that they did learn has slipped from their memory and cannot be brought to mind or used until they are given a thorough review of these subjects.

The object of the Santa Fe apprenticeship system is not to make mechanical engineers, but to make first-class skilled mechanics, to recruit the shop forces with men trained and educated the "Santa Fe Way." This object is ever borne in mind in mapping out the courses of instruction. The subjects taught and methods used are such as are deemed most beneficial to those of the rank and file, the base of the pyramid referred to years ago by George M. Basford as the foundation of the railroad structure. A few capable of being mechanical engineers forge to the front and are developed under the instruction and training given, but it is for the average boy, or even the backward boy, that the schools have been provided. The methods used are therefore very simple and the subjects taught are those which will be most helpful to a mechanic of the shop.

Subjects Taught and Lesson Sheets Used

The subjects taught are mechanical and freehand drawing, sketching, shop mathematics, the simpler elements of mechanics, business letter writing, the locomotive folio (a book of company standards and practices), Federal rules for maintenance of locomotives and boilers, A. R. A. rules for the carman apprentices and other subjects pertaining to each trade. Lesson sheets instead of text books are used. These are prepared in the office of the supervisor of apprentices, printed on the department's own press, and issued in loose leaf form so that they may be conveniently revised and kept constantly up to date. They are thoroughly practical and made applicable to the particular needs of each apprentice. Separate lesson sheets are used for the different trades.



Map Showing the Location of the 44 Apprentice Schools on the Santa Fe System

These lesson sheets include lists of questions pertaining to each trade. These questions are used not so much to test the knowledge and ability of the apprentices as to assist him in becoming familiar with the various subjects pertaining to his trade. The apprentice is permitted to find out the answers in any way he can, is given such assistance as is necessary but left free to work out many problems himself. After studying the questions he is asked to write out the answers in the school room so that the instructor may know he has personal knowledge of the questions involved. These answers are then corrected, errors pointed out, and the answers re-written. After receiving the instructor's approval they are returned to the apprentice for his future reference.

The apprentice school instructors are men with both a practical and technical education. In general they have

been graduated from some college or technical school and have also served an apprenticeship on the Santa Fe. They are, therefore, familiar with the theoretical and practical operation of each device or part of a locomotive or car or shop tool and with the standards and practices of the road. Like the shop instructors they are men who not only know, but know how to tell what they know—men who by precept and example can lead and guide the young men and inspire them to maximum effort and right conduct.

All Instruction Individual

Much of the success of the apprentice system is attributed to the fact that all instruction is individual. Each boy is treated as a unit. The bright, energetic boy passes along as rapidly as he learns the subject and is not held back because of the slower, duller boy. The slow and plodding boy moves along only as he masters his subject. Each must thoroughly know the subject, branch or class of work, before he will be moved to another. This does not mean, however, that any apprentice is permitted to idle his time or to loaf in the school room, any more than in the shop.

School Room Schedules Show Amount of Work Done

Schedules have been prepared, based on long experience, showing the number of drawings, problems, etc., each apprentice should complete during each period of his apprenticeship in order to complete all the work of the prescribed course. In general the four years' school work of a machinist apprentice consists of:

	Hours
Drawing	646
Mathematics	70
Locomotive folio	20
Valves	15
Air brakes	10
Locomotive rules	10
B. M. rules	5
A. R. A. rules	10
Final examination	30
Miscellaneous	16
Total	832

Certain features of the schedule, such as a study of the boilermaker rules, and A. R. A. rules, may not seem applicable to the machinist apprentices. They are included in this course so that those of special talent may know something about these subjects and be better prepared for a supervisory position at some smaller point. Schedules similar to the one shown above have been prepared for other trades. Each apprentice is kept constantly advised as to whether he is ahead or behind the established schedule, either as to hours of school attendance, drawings, problems, or other work completed.

These schedules have been found of great assistance in increasing the quantity of work done in the schoolroom and in measuring the ability of each apprentice. Since each drawing and problem, or set of answers to questions, must receive the approval of the instructor before the apprentice is permitted to advance to the next lesson, the quality of work done in no way suffers from this incentive to greater effort. An apprentice who is up to the schedule is permitted to do such other work as his instructor deems most beneficial.

Practical Lessons in Shop Mathematics

The lessons in shop mathematics are all clothed in the language of the shop. The examples given relate to some problems with which the apprentice comes in contact in his regular work. They begin with the simpler elements of arithmetic so as to provide the needed review, and advance by easy steps to the more complicated mathematical problems. They include such principles of arithmetic, algebra, geometry or trigonometry, as may be needed to solve the actual problems of a skilled mechanic in the shop.

Advanced apprentice pupils having a previous high school education are first given the regular course and upon completion of this are given work in higher mathematics so as to fit them for special duties. But the regular course is designed for the average apprentice who is being prepared for the work, not of a mechanical engineer but that of a skilled mechanic in the shop.

Method of Teaching Drawing

The purpose of the course in drawing is to prepare the apprentice to read blueprints readily and intelligently and to be able to make sketches whenever desired. The method of teaching drawing differs radically from that ordinarily used in technical or other schools. From the start the apprentice makes actual mechanical drawings from models or the actual parts of a locomotive or car. Geometrical exercises are introduced only as they are needed. The lessons are graded so that the apprentice may advance gradually from the simple to the complex. Each drawing must be approved by the instructor before the apprentice takes up the next. In the first lesson, the apprentice is required to reproduce three views of the drawing of a simple object. In the next lesson one view is missing and must be supplied by the apprentice. Then comes a drawing showing a hidden line, later one which involves the use of the triangle; still later, exercises are given involving circles and arcs and the use of the protractor. The apprentice advances by easy steps and is given only one new principle at a time with sufficient repetition to fix the various principles firmly in mind. Sufficient instructions are given on each lesson sheet so that apprentices require little assistance from the instructor. This makes it possible for one instructor to supervise the work of as many as 20 or 25 apprentices, even though all are working on different lessons.

SANTA FE SYSTEM
APPRENTICE SCHOOLS

Questions of Shop Work
Machinist Apprentices

FEDERAL INSPECTION

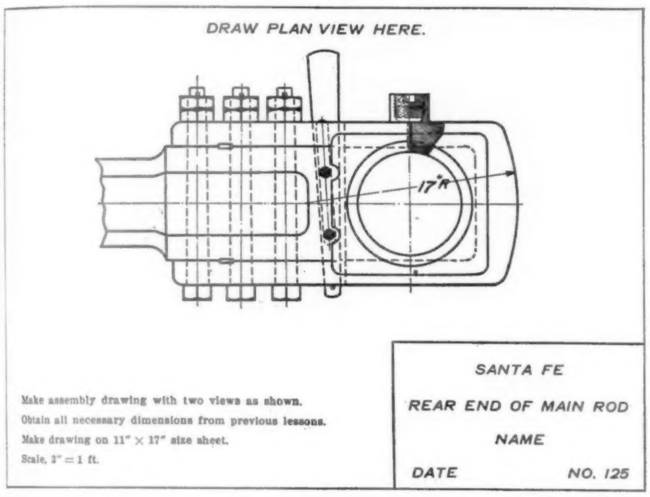
1. What are Federal Rules? Are you familiar with them?
2. Where and how should steam gauge be located? How often should it be tested?
3. Explain fully how safety valves should be set.
4. How many gauge cocks must a locomotive have? Where located? Do Federal Rules differ from Santa Fe Rules regarding gauge cocks? In what respect?
5. How should brake and signal equipment be maintained and when tested?
6. What is the maximum allowable lateral on engine truck wheels? Trailer wheels? Driving wheels?
7. How should crossheads be maintained and what is the maximum amount of lateral allowable?
8. How often should draw bar and draw bar pins between engine and tender be inspected? How much lost motion is allowable between engine and tank?
9. Give five Government defects of driving wheels and tires that will cause an engine to be removed from service.
10. Give ten other Government defects that will cause an engine to be removed from service.

(Apprentice should first write the answers on arithmetic pad. After correcting, he must print on regular drawing sheet).

General Questions Which the Machinist Apprentice Must Answer

Separate Drawing Lessons for Each Trade

The first one hundred lessons are common to apprentices of all trades and serve to establish general principles and to give the apprentice facility in lettering and in the use of the various instruments. The remaining hundred lessons of the drawing course are made applicable to each particular trade, there being a different set of lessons for each trade. All lessons apply to the work with which the apprentice must be made familiar. Boilermaker apprentices are given work in laying out; also, in calculating the strength of patches. Carman apprentices are given lessons relating to the repair of freight cars, safety appliances and A. R. A. rules of interchange. So with all trades. The objects used in all drawing lessons are those which the apprentice finds in his daily work. He must not only know how to make an accurate drawing of each object or model used in the course, but must know where the object is used and its purpose. Most of the work in drawing is done with pencil rather than with ink, the object being not to make draftsmen, but skilled mechanics who can read blueprints readily and make accurate, intelligent sketches.



A Drawing Problem

Developing Draftsmen

The boy with talent in drawing is given special opportunity, including work with ink and on tracing cloth, to develop him into a first-class draftsman. In fact, nearly every graduate of the course is thoroughly qualified for any drafting work that may arise, either in the shop or in the drawing room. Many of the draftsmen in the office of the mechanical engineer are graduate apprentices who have not only ability as draftsmen but also the practical knowledge of a trade. The shop drawing and sketching at each of the various shops and roundhouses is done by an apprentice detailed for such work under the supervision of the school instructor. Apprentices are assigned to such tasks in rotation, so that each may have about one month's experience on such work.

Synopsis of School Work

The illustrations are suggestive of the nature of the drawing lessons, and speak for themselves. Illustrations of representative lessons in mathematics and of the questions which apprentices must answer, are also given. All of this work is done in the schoolroom, under the guidance and supervision of the instructor. The schedule of school work for each trade stipulates the approximate time to be devoted to each class of work, this being varied, of course, according to the ability and progress of each apprentice.

Each schoolroom is freely supplied not only with railway publications but also with literature issued by the various railway supply companies relative to devices in use in that particular territory. In fact, when new devices or appliances come out, the instructors and apprentices are often the first to become familiar with their installation, operation, and maintenance. Each school also has its reference library and reading table. No apprentice, however, is permitted to do any special work in the schoolroom unless he has completed the standard requirements prescribed for an apprentice of his age in service.

The work outlined in the lesson sheets is supplemented by oral instructions given by the instructor to the apprentices, individually or collectively. Frequently talks or lectures are given by the instructor on educational or practical subjects. Sometimes talks are given by railway officers or by railway supplymen or other experts along special lines. Occasionally use is made of the moving picture to show the construction and operation and method of making repairs to a particular device.

Use is also made of working models, particularly in teaching valve motion. The school instructor works in harmony with the shop instructor, so that when an apprentice is working on certain classes of shop work he may at that time or just previously be given work in the school which will assist him in mastering his work in the shop. Nothing is left undone to make the instruction given in the schoolroom as efficient and practical and beneficial as it is possible to make it. Perhaps no single feature of this training system is more beneficial than is the opportunity given each apprentice to ask questions about matters in which he is interested or in doubt. Not only is he given the opportunity of asking questions but he is urged to do so, being assured that no matter how simple or uncalled for his question may appear, it will be answered freely and without ridicule. If the instructor is not prepared to answer questions offhand, he is in position to refer the question to someone who can give a satisfactory answer.

Santa Fe System **150 X**
Apprentice Schools.

QUESTIONS ON SHOP WORK
CARMAN APPRENTICES

LUBRICATION

1. How should packing for lubricating car journals be prepared?
2. What should be done with packing when it is necessary to jack up box to remove brass?
3. Give an outline of how a journal box should be packed to insure proper lubrication.
4. Should water-soaked packing be reapplied?
5. Give proper method of inspecting a journal box to see that it is properly packed.
6. What equipment is used in packing journal boxes?
7. What do you understand by the term "hot-box?" Name several of the principal causes of same.
8. What is meant by "periodical repacking" of journal boxes?
9. When changing wheels on cars what special precautions must be taken in regard to packing, brasses, wedges, dust guards, etc?
10. Give the names of six parts of an assembled journal box and the function of each.

A Typical Sheet of Shop Work Questions for the Carman Apprentice

Two features of the school instruction differ materially from that given in the public schools—first, the individual rather than class instruction; and second, the use of the object itself or a model thereof rather than a blueprint or sketch. Nothing is taught the apprentice in the abstract which can be given a concrete illustration, or made directly applicable to the trade the apprentice is learning.

Results from School Instruction Justifies Cost

It is more difficult to measure the results received from the school instruction than those received from the shop in-

struction, but they are such that it, too, more than justifies its cost.

The apprentices are taught to think, to use their heads as well as their hands. Their ability to read blueprints readily makes them more accurate and efficient in their shop work. More and better work is done by the apprentices in the shop because of the training received in these shop schools. Incidentally, a much better class of boys are attracted because of the opportunities offered in the apprentice schools. They, in turn, do more work and better work and make better mechanics than boys of lesser ability who would otherwise be employed. From these boys of greater fitness are developed not only mechanics for the rank and file, but men for staff duties, for foremanship and other positions of leadership.

Report of Committee on Feedwater Heaters*

The number of feedwater heaters applied or on order up to May 1, 1924, is 2,123. During the current year heaters have been applied on 21 switching locomotives and the roads report savings in this service.

The report gave a brief summary of the difficulties being encountered in the maintenance of both open and closed type heaters and the means which have been, or are being developed to overcome them. Some of these are being overcome by a redesign of the parts and others by modifications in heater operating practice.

Exhaust Steam Injectors

The exhaust steam injector has been tried out on nine different roads in this country and on a total of 24 locomotives. The first design, of which 19 were applied, involved the use of levers for controlling the injector. The last five injectors applied are equipped with a single control valve somewhat like an engineer's brake valve which distributes steam to pistons for operating the various valves and greatly simplifies the handling of the feedwater injector by the engine crew.

Objections to the exhaust injector as compared with the feedwater heater pumps are its limited range, which is about the same as that of the live steam injectors, and its falling off in economy as the temperature of the water in the tender increases. One road which had a Mallet locomotive equipped with an exhaust steam injector in mountain territory, exchanged the original for one of smaller size in order to be able to use it continually instead of cutting it in and out of service.

The road, which has the greatest number of exhaust steam injectors in service, reports after a two-years' service test practically no trouble to get the men to operate the injectors as they become more familiar with them; that the superheat temperature obtained with the injector working exhaust steam is about 15 deg. less than when working the live steam injector; that the exhaust steam injector when using exhaust steam requires more attention than the live steam injector, but is as reliable as the live steam injector when in good condition, and that it will not blow back in the tank or work improperly without giving indication at the overflow. This road reports that the exhaust steam injector undoubtedly requires more terminal attention than the average live steam instrument because there are more parts.

The committee states that the reports to date indicate that the savings made in light service are small and increase as the capacity of the boiler is approached.

*Abstract of a report and a paper presented before the convention of the International Railway Fuel Associations held at Chicago, May 26 to 29, 1924.

Feedwater Purifier

The committee finds that only one road has a purifier under test together with the open type feedwater heater. This has not been in service for a sufficient time to determine the full benefit. The report from this road indicates that they are assigned to a bad water district and are showing improved conditions when compared with locomotives not so equipped. The feedwater enters the boilers at about 300 deg. F.

The purifiers are made up of cast iron bodies fitted with steel troughs. These troughs are filled with a series of dams. The feedwater passes into the purifier which is under boiler pressure through a standard boiler check and the water in going through the purifier drops some of its scaling constituents. From there it is carried to the bottom of the boiler barrel by two more troughs inside the boiler, one on each side. It has been found that a portion of the incrusting solids precipitate and are carried to the bottom of the barrel, from which they are removed through a perforated pipe connection to one of the blow-off cocks. The purifier troughs can be removed through the end of the purifier and cleaned.

No arrangement has been made for the gases which tend to accelerate corrosion to be left in the steam space or automatically removed before the water goes to the boiler, other than that provided by an open type feedwater heater. Tests have been made on railways where the open type of feedwater heaters was standard and it is reported that from 85 to 90 per cent of the oxygen from the feedwater supply has been eliminated.

Feedwater Heating in Terminals

It has been conservatively estimated that 20 per cent of all locomotive fuel is consumed at terminals and since none of the fuel burned at terminals is productive from a transportation standpoint, this loss is a serious one. That part which is incident to moving locomotives to and from the trains is to some extent unavoidable. Another terminal fuel loss is proportional to the time locomotives are held under steam. This can be lessened by giving the matter more methodical attention and by enlarging or rearranging locomotive terminal facilities to conserve heat in water from boilers blown down and return it to boilers as hot water when filled up in preparation for road service so that the motive power can move more promptly to and from the enginehouse. At least half the locomotive fuel consumed at terminals, however, is incurred in heating the water supplied to locomotive boilers that have been washed or refilled, and to this must be added the fuel burned in stationary boilers on account of the blower steam required by locomotives being steamed up. The extent of this loss depends on the temperature difference between water supplied to the boiler and the steam generated.

Fuel saving can be accomplished by filling the boilers with a mixture of steam and hot water at such pressure and temperature that a working steam pressure can be built up in the locomotive before the fire is lighted. The use of otherwise waste steam from boilers being blown down as a heating medium is a straight saving and the use of live steam as a direct feedwater heating medium increases the quantity of steam supplied by the stationary boilers but eliminates the necessity for using stationary boiler plant steam in the stack blower so that all of the heat in this steam is conserved. Tests of this direct steaming method are now under way and it is proposed that the committee extend the scope of its work for the coming year to include a study of the fuel economies resulting from this method and other approved practices for heating feed water at terminals.

The members of the committee are E. E. Chapman, A. T. & S. F., chairman; E. A. Averill, Superheater Company; S. H. Bray, Southern Pacific; J. A. Carney, Chicago, Burlington & Quincy; V. L. Jones, New York, New Haven & Hartford; A. G. Hoppe, Chicago, Milwaukee & St. Paul;

J. M. Lammedee, Worthington Pump & Machinery Corp.; H. A. Macbeth, New York, Chicago & St. Louis; L. P. Michael, Chicago & North Western; George S. Mikles, New York, Ontario & Western; George E. Murray, Grand Trunk Western; L. G. Plant, National Boiler Washing Company, and J. M. Snodgrass, University of Illinois.

Discussion

The discussion of this report indicated that defects in the design and construction of early types of feedwater heaters have been largely corrected in present designs. One member from the Southern Pacific stated that this road has 187 feedwater heaters of the open and closed types in service, experience showing that both types have successfully passed the experimental stage. The member commented particularly on the reduction in the number of water stops possible with feedwater heater equipped locomotives owing to the return to the tender of 1,500 gallons out of every 10,000 gallons of water supplied.

P. O. Wood, assistant superintendent of motive power of the St. Louis-San Francisco stated that feedwater heaters of both types used on the Frisco are efficient, have developed no excessive maintenance cost, and have been in service 12 months with very satisfactory results. He said that the closed type of heaters is washed once a month, this being at the time of the monthly inspection. Experience shows that the washing operation is simple and can be readily handled while doing the other work performed on the locomotives at this time. A member from the Santa Fe stated that operation of the closed type of heater in bad water country developed that the feed temperature of 240 deg. F., with a clean heater dropped to 205 deg. after the locomotive had made about 1,200 miles.

As a result the washing period is based on mileage and 1,200 miles has been selected as it is not desired to have the feedwater temperature drop below 205 deg. F.

There was considerable discussion of the exhaust steam injector, J. B. Hurley of the Wabash stating that, in his experience, the exhaust steam injector works satisfactorily as long as there is no change in cut-off or throttle opening. Otherwise water is wasted at the overflow. Mr. Hurley stated that the injector must be made to regulate itself automatically before it can be a success. Another member from the Kansas City Southern said that the loss of water at the overflow was frequently occasioned by too high a back pressure caused by the engineman lengthening the cut-off in anticipation of a grade. This was the fault of the engineman and should not be charged against the exhaust steam injector.

Oil and Coal as Locomotive Fuels

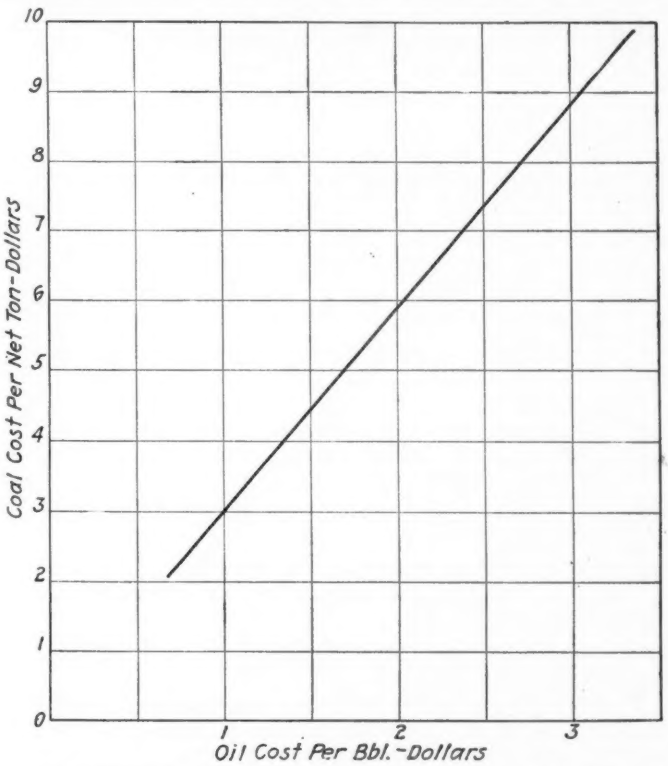
By M. C. M. Hatch

Mechanical Superintendent, Missouri-Kansas-Texas, Dallas, Tex.

The fuel, whether it be oil or coal, that will give the greatest amount of work at the draw-bar for every dollar expended is the one to use. When we buy a ton of coal or a barrel of oil, the feature of interest is the number of heat units obtained for the money. The average B.t.u. content of bituminous coal used for locomotive fuel is about 12,500 per lb. and for oil this figure is 18,500 per lb. Oil weighs 7½ lb. per gal. and 180 gal. of oil will therefore contain the same number of heat units as one short ton of coal. Relative boiler efficiencies must be taken into account, however, before any such comparison is of value and, from the best test figures available it appears that, with coal, we can look for a combined efficiency of about 62.5 per cent, while with oil this figure becomes 75 per cent. With due consideration of these relative figures the equivalent heat value of 2,000 lb. of coal is the same as that of 150 gal. of oil, The American Railway Association has recommended that, in order to establish a uniform basis for comparison, a standard equivalent figure of 160 gal. to the ton be used.

Locomotive boiler maintenance, when oil fired, has been discussed a great many times and decided opinions expressed to the effect that oil shortens the life of the firebox, other opinions being as strongly stated that this is not the case and that no additional expense need be feared. Personally, I favor the latter view. If we base our figures on the actual work done by the locomotive there will be no appreciable difference in boiler maintenance between oil and coal firing.

The cost of converting from coal to oil burning is influenced by numerous factors and for large modern power the net cost is found to be about $1,500 a locomotive. It is not easy to determine exactly what will happen to operating costs if oil be substituted for coal. Fewer engines will be needed to handle a given tonnage or the same number can handle a greater tonnage. Locomotives can stay out of the enginehouse a greater proportion of the time and long runs are possible that could not be made with coal. For example, the M.-K.-T. is running large Pacifics through in heavy, fast

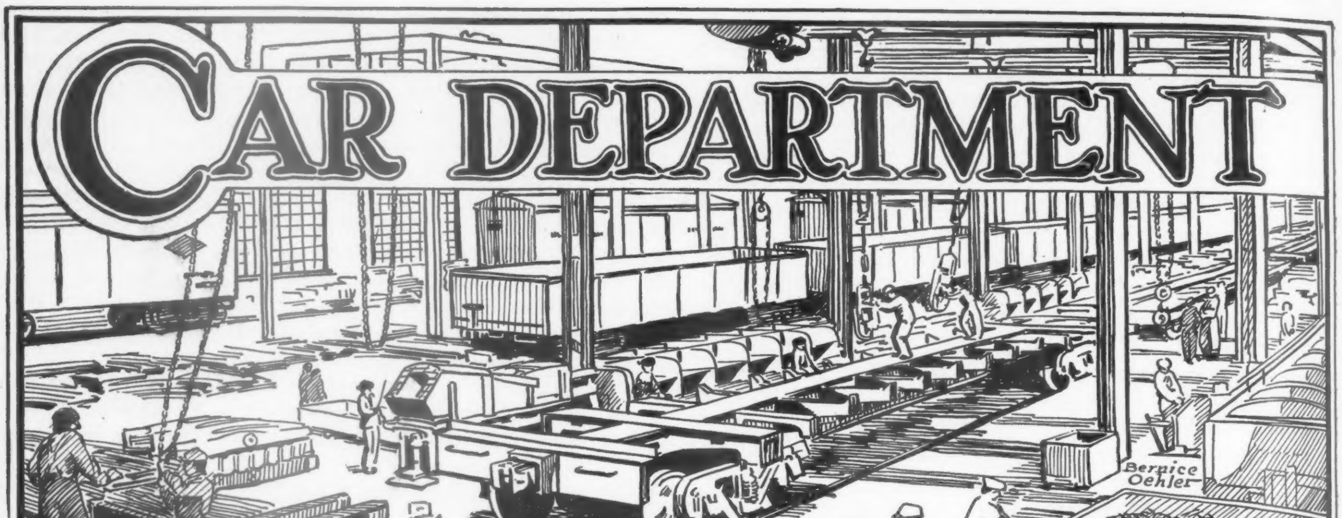


Curve Showing "Balance" Prices Between Fuel Oil Per Bbl. and Coal Per Net Ton, Both on the Locomotive Tender

passenger service from Franklin, Mo., to San Antonio, Tex., a distance of 876 miles, five crews handling the engine. With this long run in effect for several months, the results attained have been most satisfactory.

For any railroad contemplating the possibility of a changeover from coal to oil or the necessity of changing back from oil to coal, the thing to be determined is the balance in price between the two fuels. With coal at $5 a ton, on the tender, what price oil per barrel will develop the same amount of work or, with $1.25 oil how much should one pay for coal before seriously considering a change? The curve shown indicates, in a general way, where this balance will fall. This has been calculated on the basis of a careful consideration of all the factors involved. For all practical purposes, this curve shows that when the price of oil per barrel on the tender decreases to less than one-third the price of coal per ton on the tender the changeover from coal to oil or the reverse should be considered. This curve was drawn with the due consideration of relative boiler efficiencies, stand-by and other losses.

Locomotives - Fuel



Maintenance the Key to Hot Box Prevention*

Thorough Inspection Enables the Carman to Anticipate Approaching Trouble

Car

Cars - Bearings
Hot boxes

By M. S. Roberts

THE subject of hot boxes is an old one, as old as the railroads, but, unfortunately, forever new. Hot boxes will undoubtedly be a source of serious trouble until there is a radical improvement in the design of journal bearings and journal boxes. Such a change will involve great expenditures, almost prohibitive at this time.

The problem which railroad mechanical department supervising officers have to face is, therefore, means and methods by which the present standard parts can be maintained so that hot boxes will be kept at a minimum.

Contrary to ideas too frequently expressed by men who should know better, every hot box has a cause. And it is a waste of time to explain causes after the event when in most every case the event would not happen had proper preventive measures been taken.

The suggestions to be given are based on actual experience covering several years in close contact with this subject at one of the largest terminals in the country where every kind of traffic is handled in large quantities, and are treated under three general headings.

Regular Inspection of Journal Boxes and Contained Parts, Including the Packing

First—Passenger cars in through service.—Such cars must be inspected carefully at each originating terminal. If any box is found to be hot or above a good running heat upon arrival of the train, such box must be chalk marked for special attention when the train is placed in the storage yard. There may be a condition gradually becoming serious which will be caught in this manner, which might otherwise be overlooked when the regular yard inspection is made later after the journals have had time to become cold. In the storage yard close attention is given to the condition of all parts from the journal box itself through all the contained parts to the packing. The following details are covered: Fit of journal box in pedestal; journal, especially its size; journal bearing lining and packing. In case of the slightest doubt as to the condition of the journal bearing the box should be jacked, bearing removed and inspected. Before the box is jacked down again, the fit of journal bearing wedge on roof of box should be checked. The packing must not be allowed to remain in box if it is dirty or partially destroyed. If it is in good condition, it must be leveled all the way back and, if dry, given a small amount of free oil.

Second—Passenger cars in local service.—If all such cars are given the thorough inspection and attention outlined above (for cars in through service, once each week), it has been found that they will run with almost no trouble. The inspector indicates time and place of such inspection with a suitable chalk mark on the needle beam of the car. This facilitates the work and insures against cars being cared for within or beyond the prescribed period.

In very cold weather it is important that extra men be assigned to assist the regular force of box packers and inspectors. More time is needed to loosen up the waste which is sometimes found partly frozen, and more repacking is necessary at such times. It is also important to open the boxes of local cars more frequently than once a week in the cold weather, not only because of the danger of frozen packing, but also to replace packing which is removed by irresponsible or mischievous persons for the purposes of starting fires or thawing out steam pipes.

Condition of Journals, Bearings, Boxes, Wedges, Etc., When Wheels Are Changed

When it is necessary to change wheels, the most careful attention is given to those parts mentioned in the above title. Standard practices of the railroad (which are more rigid in these respects than the A. R. A. rules) are used to check journal measurements; that is, diameter of journal,

* Awarded first prize in competition on hot box prevention which closed March 1, 1924. The prize awards were announced in the *Railway Mechanical Engineer* for July, 1924.

length of journal, thickness of collar and whether straight or tapered. But the condition of the surface of the journal is of the utmost importance and here is where the greatest of care has to be taken. If there are any marks on the journal which cannot be removed with medium sand paper, the journal must be trued. Under no circumstances is the use of emery cloth on journals permitted. Second hand journal bearings are never used when wheels are changed. The lining of the new bearing is filed in order to insure removal of any abrasive particles from its surface. The bearing is also spotted to the journal in order to insure an initial crown bearing. At the time the wheels are changed, the pedestal bearing of journal box is checked and, if the amount of play between pedestal and box is excessive, necessary corrections are made.

Another item taken care of at this time is the bearing between roof of journal box and crown of journal bearing wedge. The importance of providing a lateral rocking surface between these two parts is frequently overlooked. In connection with this job, the condition of the other boxes on the car which is receiving the new wheels is carefully noted and whatever may be necessary to put the car in first-class running condition is done. Of course, the boxes of the new wheels are packed with new dope and frequently it is found advisable to repack the entire set of boxes. A final check of the shop work on wheels is made by inspecting the boxes of the new wheels immediately after the car is moved to the storage yard for its make-up in a train. If the work has not been done properly, one or both of the new journals will show signs of heating even in this comparatively short movement.

Preparation of Journal Box Packing

It is not the purpose of this article to discuss comparative merits of various types of journal box packing, the assumption being that good waste, with proper resiliency and of high capillary power, is being furnished. However, the proper soaking and draining of the dope is a most essential factor in the matter of satisfactory journal box conditions, and, therefore, care must be taken to have this work done in accordance with the well-known standard practice. The importance of properly applying dope to journal boxes should not be overlooked, for the finest of material cannot function if it is not placed so that it can transmit the greatest possible amount of oil to the surface of the journal.

Cars in through passenger service should be repacked every four to six months and one of these times should certainly be just before the beginning of winter. Cars in local service should be repacked every six months if possible.

Freight Train Cars

The foregoing discussion has dealt altogether with the handling of passenger equipment. Such careful attention cannot necessarily be given to freight equipment, but an effort should be made to handle such equipment in the same general manner because the loss of money due to delayed shipments can be, and frequently is, very great. Freight cars in order to be in good condition for a long run must be right leaving the originating point. It is, therefore, essential that they be carefully inspected immediately on arrival at which time any bad journals will be most easily found. In this manner cars requiring a change of wheels can be put on the repair track as soon as they are empty, instead of being reloaded and later cut out when half way over the division and then returned for a change of wheels. All journal boxes on outgoing trains should have the covers raised, journals and brasses inspected, packing adjusted or renewed if necessary, and some free oil added, as this is nearly always needed.

At intermediate terminals a running inspection is frequently all that can be made, but usually any car which is getting into a condition where trouble is imminent can be detected and taken out of the train for change of wheels. In some cases a change of journal bearing or repacking of the box will prevent further trouble.

Conclusion

In the foregoing article an endeavor has been made to touch upon the most important considerations in connection with hot box prevention. Perhaps nothing new has been said, but too much emphasis cannot be laid upon the importance of close inspection, honest maintenance and the use of first-class materials in the never-ending effort to keep hot boxes at the lowest possible minimum.

Car couplings

Relation of Key Connection to Coupler Action

By C. R. Harding
Consulting Engineer, Southern Pacific Company

It is an axiom of mechanics that relative angular movement between two connected members cannot take place unless the connection is sufficiently flexible. The old riveted wrought draft yoke was inflexibly connected through the coupler butt and the failure of this riveted connection was a frequent cause of break-in-twos. A glance at Fig. 1 shows the tremendous leverage which is exerted upon the two closely spaced 1¼ in. yoke rivets at every side swing of the coupler.

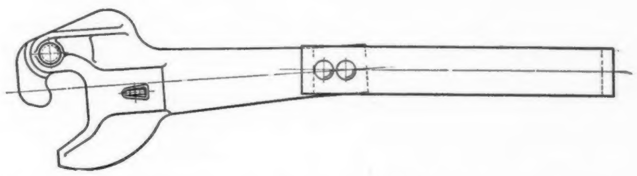


Fig. 1—Showing Leverage Exerted on Rivets by Side Swing

Vertical movement of the coupler tends to spread and bend the riveted yoke and to stretch the rivets as shown in Fig. 2.

The adoption of the present standard horizontal coupler key provided a device which solved the greater number of the problems involved in the development of an efficient connection between the coupler and the draft yoke. For the sidewise movement illustrated in Fig. 1 it provided a certain amount of clearance in the coupler shank key slot. This means merely the substitution of flexibility through the loose connection of the related parts instead of a form of connection which would have produced a true radial device. Nevertheless the horizontal key has proved remarkably satisfactory in the performance of its various functions.

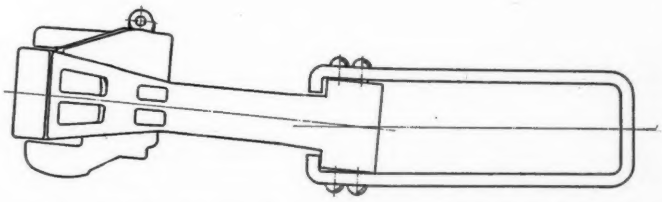


Fig. 2—Vertical Movement Spreads Yoke and Stretches Rivets

The substitution of a vertical key or pin for the present horizontal key has frequently been proposed but before seriously considering a permitted departure from the existing standard connection, it would appear well to bear in mind that the horizontal key has other important functions than merely providing an effective tension connection between

the coupler and yoke. It certainly serves as the simplest means of maintaining the coupler shank in its proper position and affords in itself an adequate guide without the necessity for additional carriers, bolted or otherwise. The horizontal key also provides a positive emergency connection which comes into action in the event of yoke or draft gear breakage or of excessive wear. Surveys on old equipment show that almost invariably the coupler key frequently makes contact against the forward ends of the sill slots. The elimination of this safety stop might conceivably result in a great increase in the number of break-in-twos. The present horizontal key provides adequately for the vertical angular movement of the coupler, as the clearance in the key slot permits the key to angle slightly with reference to the yoke and also permits the coupler to move through an equal angle with reference to the key. This is shown in Fig. 3.

Any vertical key device with which the writer is familiar

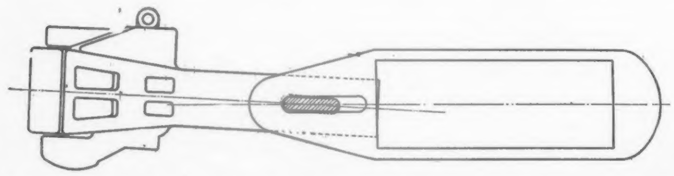


Fig. 3—The Horizontal Key Provides Adequately for Vertical Angular Movement

does not provide full key bearing under vertical coupler movement. Standard practice requires a clearance of ¾ in. between the top of the coupler shank and the striking plate. Sagging or worn coupler carrier irons might easily permit an appreciable movement below the horizontal plane. Vertical movement results when the car ahead enters or leaves a grade and also when empty and loaded cars are coupled together or where the coupler of one car is at the maximum height while the other is down to the permissible minimum. The behavior of a vertical keyed coupler under these circumstances is shown in Fig. 4.

The present A.R.A. standard 6-in. by 1½-in. horizontal coupler key meets all the requirements of service with the exception of the following theoretically desirable features:

(A) Under pull with the coupler angled horizontally, one side of the yoke is subjected to greater stress than the other.

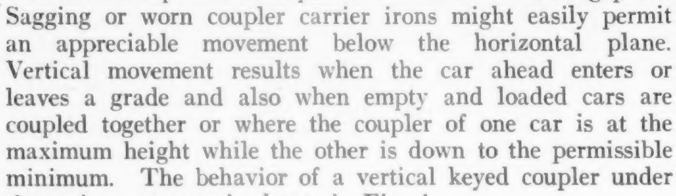


Fig. 4—Showing Lack of Key Bearing in Vertical Key Connection

(B) Under pull with the coupler angled horizontally, the bearing between key and coupler is to one side of the coupler.

(C) Under buff shocks with the coupler angled horizontally, there is not an evenly distributed bearing of the coupler butt on the draft gear.

So far as known, no practical difficulty has ever arisen on account of the above theoretical objections.

With the vertical key coupler, the following conditions will be obtained:

(A) Under pull with the coupler angled vertically, one arm of the yoke is subjected to greater stress than the other.

(B) Under pull with the coupler angled vertically, the bearing between key and coupler is either at the top or bottom of the coupler.

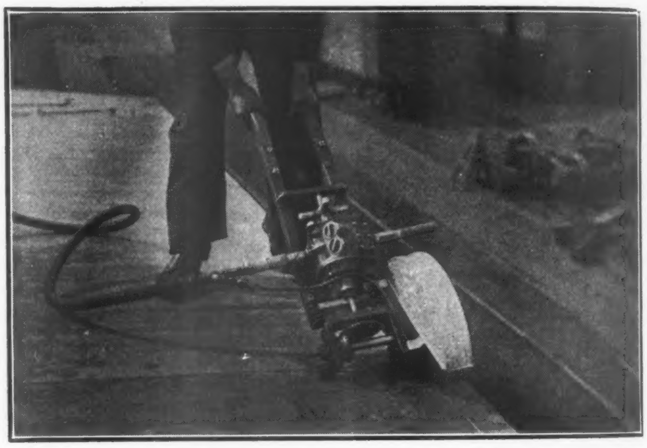
(C) Under buff shocks with the coupler angled vertically, there is not an evenly distributed bearing of the coupler butt on the draft gear.

The complete requirements for a coupler which shall accommodate itself to all service movements seem to be these: The use of a horizontal key for the purpose of maintaining the shank of the coupler in its proper position, and to provide a positive emergency connection between the coupler and the car underframe in the event of yoke or draft gear breakage; the maintenance of substantially uniform stress under pull in the key and both arms of the yoke regardless of coupler angularity, and the maintenance of substantially uniform contact between the coupler butt and the draft gear under buff regardless of coupler angularity.

Portable Trimming Saws

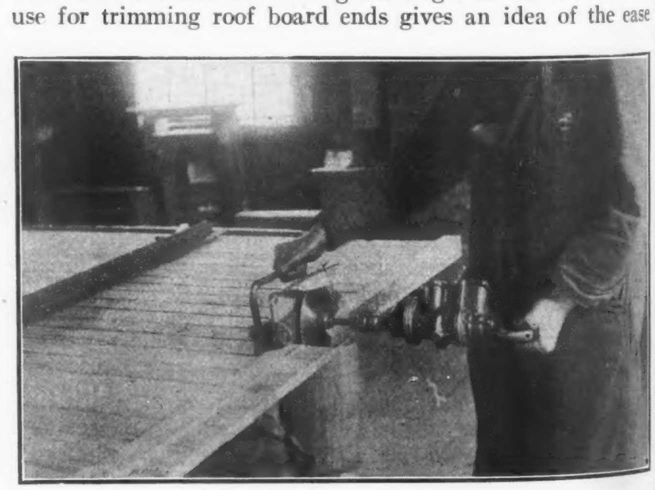
By E. A. Murray

THE two illustrations accompanying this article show the general construction and the use of two types of portable air operated circular saws which have been developed for use in trimming the ends from roof and door boards in wood car repair work. The simplicity of construction and the



The Large Portable Saw Effects a Great Saving in Time on Jobs Like This

adaptability of this device should particularly appeal to the car repair foreman, not to mention its time-saving possibilities. The illustration showing the larger of the two saws in use for trimming roof board ends gives an idea of the ease



The Light Weight Pneumatic Saw Is a Handy Tool for Trimming Door Board Ends

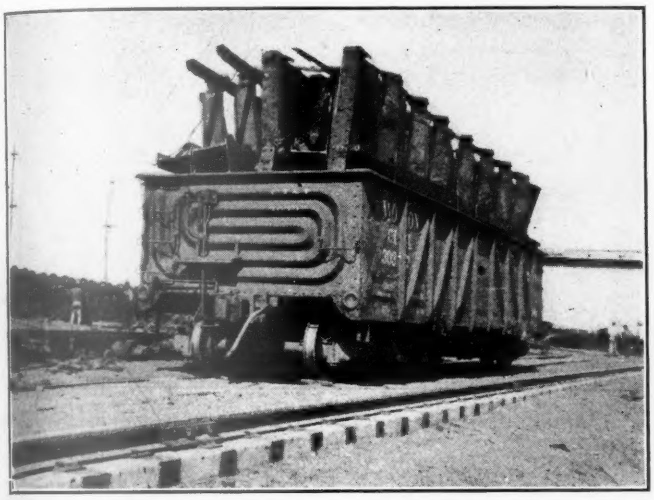
with which this work may be accomplished. This operation alone formerly required 80 minutes when using a hand-saw, and by the use of the portable saw, the time has been reduced to 25 minutes.

Railroads) - Scrap material
Freight cars, Steel
- Dismantling

Burlington Dismantles Cars at Eola Scrap Dock

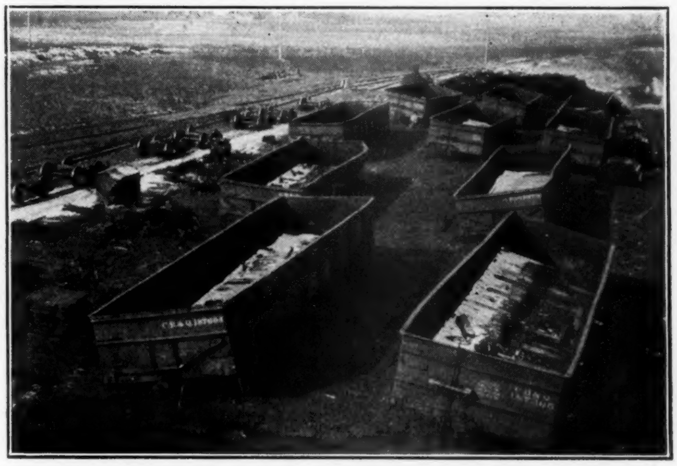
Total Unit Cost of Scrapping 300 Steel Gondolas Amounts to Slightly Less Than $16 per Car

A FEATURE of unusual interest in connection with the scrapping of 300 steel gondolas, series 187,000, for the Chicago, Burlington & Quincy, was the arrangement to have their work done at the recently completed Eola scrap dock under the supervision of the Aurora, Ill., stores department. There was no intention to intrude on the province of the mechanical department in assigning this work to the stores department but in this case it happened that both the space and crane facilities for expeditious handling of the work were available at Eola, whereas the cars could not be scrapped in car shops and rip tracks on the system without interfering with normal repair work.



Scrap Sills Loaded on Car Ready for Delivery to the Dealer

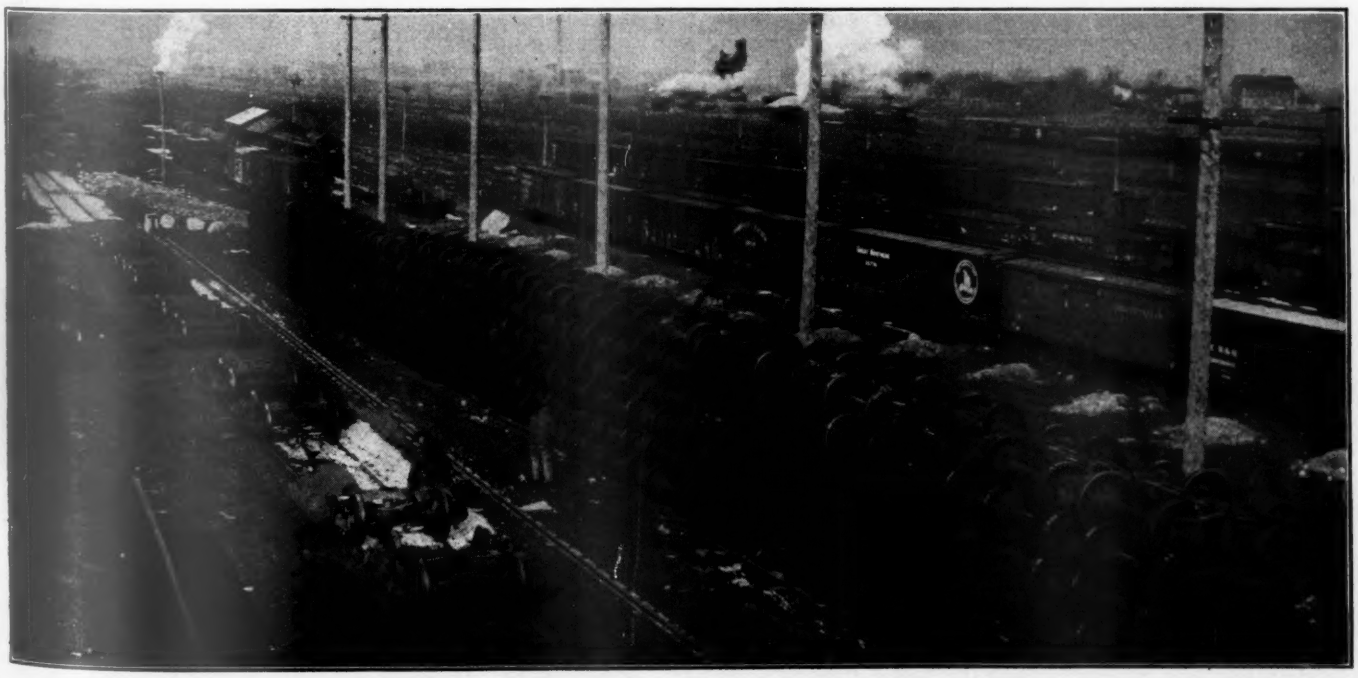
There are several other reasons why it is a paying proposition to have this work done at the Eola reclamation plant. In the first place, the provision of ample crane service enables the trucks to be piled four or even six high, as shown in the illustrations, with a resultant big saving in ground space. Moreover, by cutting up the cars right at the scrap dock where all scrap must eventually be received before delivery to scrap dealers, at least one handling of the scrap is saved. All usable material is also segregated at the scrap dock, from which it can be shipped to various points on the system as required. Last but not least, the work of scrapping the cars is being done at less expense at Eola than would be required at most car shops and rip tracks, owing to the development of specialists who have greatly cut down the time required for the various operations.



Car Bodies Are Set on the Ground Ten at a Time for Cutting Up

Description of Dismantling Operations

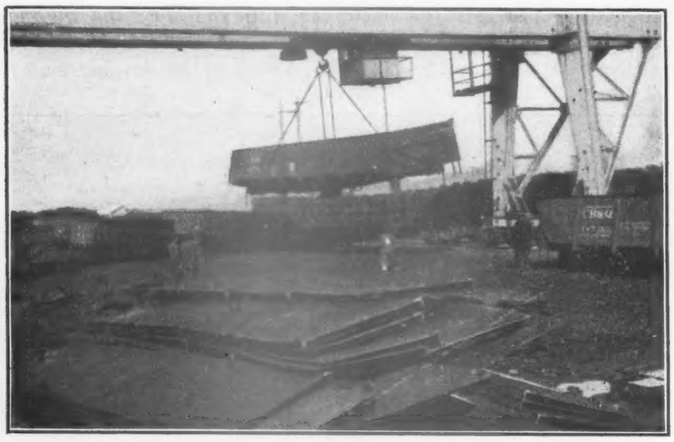
The work of dismantling cars is done by one foreman and a force of seven men, this force consisting of two operators



Space Is Saved by Piling the Trucks Six High

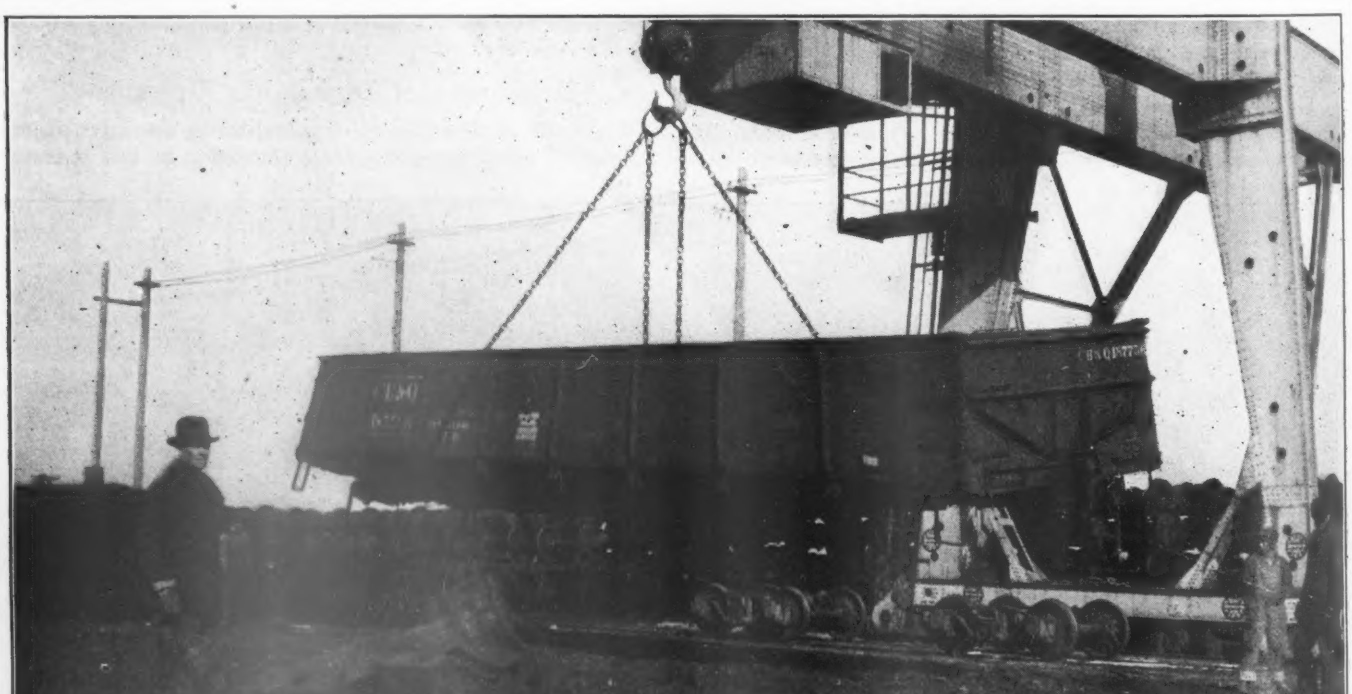
with oxyacetylene cutting torches, two operators with one-man rivet busters, two men who follow up the rivet busters and separate the car members, and one man who sorts out the usable material for the magnet. There is also a crane man and a ground man, a portion of whose time is charged to scrapping the cars. The cars are scrapped 10 at a time and the first 30 cars required 12 days, or an average of four days for each series of 10 cars. When a new series of cars is brought in, the entire force helps in disconnecting the trucks and placing the car bodies, after which each of the men takes up his own particular duties.

The first operation consists of lifting the car bodies from the trucks and placing them with the scrap dock crane on



Side Sections Cut with the Acetylene Torch Are Shown in the Foreground

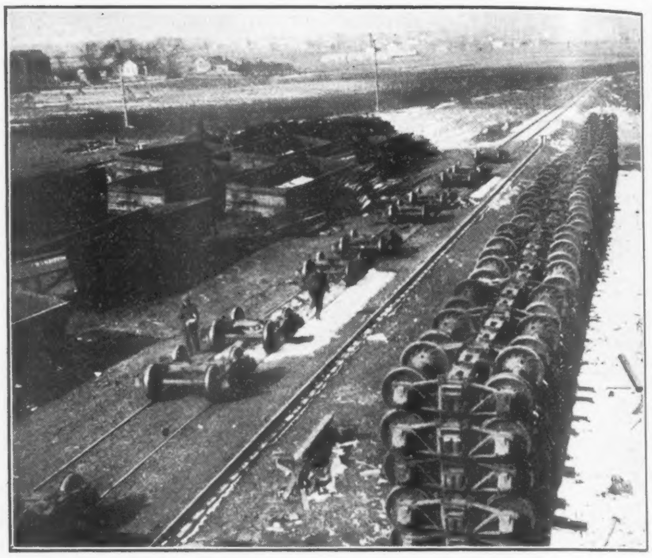
the ground where they can be readily reached for cutting up. The trucks are then picked up by the crane from the track and piled four, or in some cases even six high. The trucks



Car Bodies Are Readily Removed from the Trucks and Placed for Cutting Up, with the Scrap Dock Crane

are removed intact and not dismantled as they are to be used again in the construction of new cars. After placing the car bodies, they are cut apart along the dotted lines indicated in the sketch, the various sections then being readily handled and piled in scrap cars for delivery to the dealers. The center sills in these cars are practically all rusted out, but sound sections are cut out with the oxyacetylene torch and the channels saved for splices in steel center sills of other cars undergoing repairs at various shops on the system.

A detailed analysis of the cost of dismantling a single

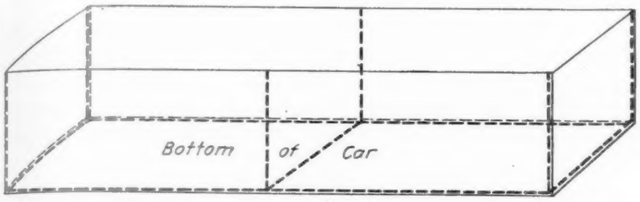


The Entire Operation Is Conducted within Reach of the Scrap Dock Crane

series of 10 cars is given in the attached table in which all items of expense are covered except overhead costs for the crane facilities and ground occupied. It takes on the average 35 min. to lift and place the 10 car bodies and 65 min. to pick up the 20 trucks from the dock and pile them four high on the ground. The ground man referred to in the analysis is provided largely in the interests of safety to give signal indications to the crane operator and to see that no one is injured in handling the material.

Referring to the analysis it will be noticed that the total

cost of lifting the 10 car bodies was $1.45 and picking up and piling the trucks $2.71. The labor cost of cutting the bodies apart amounted to $80.15 with the additional substantial charge of $60.45 for oxygen and acetylene gas. The grand total cost for the 10 cars was $158.76 or a unit cost of $15.88 per car. The scrap was sold for $882.01, the value of the good material reclaimed being $152.00 and the value



Car Bodies Are Cut with the Acetylene Torch Along the Broken Lines

of material needing repair $681.68, making a total of $2,715.69. The difference between the value of scrap and reclaimed material in these cars and the cost of dismantling them was therefore $2,556.93 or $255.69 per car.

Cost of Dismantling Ten Steel Gondolas at Eola Reclamation Plant

Lifting car bodies from trucks and placing on the dock, using the crane.			
35 min. current for crane	at $1.45 per hr.	$ .84	
35 min. crane operator	at .60 per hr.	.35	
35 min. ground man	at .45 per hr.	.26	
			$1.45
Picking up the trucks from the dock and piling four high on the ground.			
65 min. current for the crane	at $1.45 per hr.	$1.57	
65 min. crane operator	at .60 per hr.	.65	
65 min. ground man	at .45 per hr.	.49	
			2.71
Labor cost of cutting apart and stripping good material from car body.			
107 hours laborer	at $0.40 per hr.	$42.80	
83 hours laborer	at .45 per hr.	37.35	
			80.15
Material.			
13 tanks oxygen, 2,860 cu. ft.	at $1.60 hd. cu. ft.	$45.76	
2 tanks acetylene, 544 cu. ft.	at 2.70 hd. cu. ft.	14.69	
			60.45
Supervision.			
Foreman 28 hours	at $0.50 per hr.	$14.00	
			14.00
Grand total			$158.76
Total cost per car			15.88
Credits.			
Value of scrap sold		$882.01	
Value of good material reclaimed		152.00	
Value of material needing repair		681.68	
			2,715.69
Cost of dismantling			158.76
Net saving for 10 cars			$2,556.93
Net saving for 1 car			255.69

Photographs and data presented in this article are made available through the courtesy of C. J. Mackie, storekeeper of the Chicago, Burlington & Quincy at Aurora, Ill., directly in charge of the Eola reclamation plant.

Improvements in Passenger Car Construction

Work of Building and Maintenance May Be Facilitated by Adopting Uniform Equipment Designs

By C. E. Barba

Excessive weight of passenger equipment affects the cost of haulage unless the total load is within the limits of the capabilities of the prime mover. This seems to be true so long as we neglect the factor of speed. Rapid acceleration and retardation, however, demand the lowest weight consistent with comfort and safety.

To obtain reliability, safety and strength with economy are the ends sought. These features are usually obtained by the introduction of load-carrying side members, supported by an underframe capable of sustaining end shocks, a roof construction that will sustain the weight of the car body and an end construction which will resist telescopic action. There are, therefore, a number of ideals to be considered in up-to-date equipment.

A unit section between side posts should be adopted comprising two or three windows to enable the designer to obtain cars of various standard lengths by the addition or elimination of these units.

Importance of Underframe Construction

The underframe is the great vital feature of passenger equipment. Upon it depends the success or failure of the design more than any of the other members. The present designs of underframes may be divided into two classes of load transference: First, those distinguished by the absence of all bolsters, in which the static lading is all transferred at various intermediate points to the center sills, which in turn places it directly upon the center plates which are riveted to them. This type presupposes a strong center sill and may make use of a weaker side girder. The second class is those in which all the sills carry the load to a bolster. This type is characteristic of a majority of the equipment now in service.

The first type lends itself particularly to those cars which have side doors, such as the postal and baggage types. A support may be placed directly under the aperture for load transference to the center sills and the side will not need to be strengthened by a frame construction carrying the load up to the eaves and over the door.

The underframe member should be standardized by designing for the maximum length of car and, when reducing the length for shorter cars, a central unit may be removed and, when advisable, the thickness of the cover plates reduced.

The riveting can be anything that is consistent with good design, but in the central unit section it must be a constant function of the distance between posts so that the removal of such a unit will not alter the spacing. The underframe should be built with a view to clearances required for both steam and electric service and hence designed to take either motor or trailer truck.

Likewise, the standardization and location of equipment hangers, battery boxes, steam and air piping, brake rigging and false floor construction require most careful consideration, as the variety of installations, the initial cost of application and subsequent maintenance are out of all proportion for the services intended.

The adoption of a standard end, including the platform

*A brief abstract of a paper presented at a meeting of the New England Railway Club, Boston, Mass., April 8, 1924.

and vestibules, should be given consideration. The anti-telescopic features should be simplified and increased by transferring more of the load to the side members.

Standard End and Roof Construction

The form of roof construction best adapted for strength, lightness and ease of repairs is one of a semi-circular construction. U-shaped carlines are preferable, with steel sheets rolled to conform thereto. All joints should be covered with splice plates.

To facilitate a more rigid end construction, it is suggested that the present form of hood construction be eliminated and the semi-circular roof continued to the end of the vestibules. This would enable the application of a semi-circular, channel shaped pressing to be applied to the end of the roof and attached to the vestibule, which undoubtedly would decrease the wind resistance.

The elimination of the so-called "clear-story," or upper deck, is recommended as it is no longer required for the purposes for which it was originally intended. Its primary purpose was for the suspension of oil lamps and its secondary purpose for ventilation. This form of construction is expensive, considering sash frames, sash, screens, deck plate, carlines and inside mouldings. The elimination of all of these items, with the exception of a modification of the carline to conform to a semi-circular roof, decreases the weight, increases the strength of the roof as a whole, and assists in maintenance.

Change the Location of the Belt Rail

The present location of the belt rail where it is on the outside of the side sheets below the window sill should be eliminated by applying the rail in pressed recesses in the side posts, the depth of the recess being equivalent to the thickness of the belt rail.

Such an arrangement would permit the procurement of level side sheets to cover one panel only, or from the center line of one post to another with reasonable clearance between. The splice plate to cover would consist of both the post cover between the window openings and the joint of the side sheets, extending from the letter board to the bottom of the side sill. This feature has a two-fold purpose; namely, to do away with buckles in the side sheets covering two or more panels, and to facilitate repairs when the car has been wrecked or side swiped.

The window openings in the side frame may vary for construction purposes from 1/4 in. to 3/8 in. both in length and width, as the use of either an aluminum or pressed steel window frame, having suitable flanges and applied from the outside, will take care of these variations. This form of construction would require a stationary sash, thus eliminating all hardware and furring strips. The latter is quite awkward to apply on account of the location.

Proper System of Ventilation and Seating

A ventilating system to take care of the conditions previously outlined should be provided, as undoubtedly more attention has been given in the past to the development of heating passenger coaches than to ventilation. These subjects are closely interwoven and they should be considered together instead of separately.

In this connection, it might be well to mention for those directly interested in the subject of ventilation and heating of railway passenger cars that an exhaustive study on this subject was presented by K. F. Nystrom, engineer of design, Chicago, Milwaukee & St. Paul, before the Canadian Railway Club of Montreal, Canada, on February 12, 1924.†

The reversible seats now in common use should also be eliminated, thereby simplifying not only the construction, but likewise their application, substituting instead seats placed back-to-back. This would permit the application of a steel gusset between the seat backs and attaching them to the side post and floor support of the underframe. This form of construction would increase the transverse stiffness of the side framing and prevent in a large measure the buckling of the side members due to collision.

All interior finish should be made up of veneer, the core of which should be fireproof. The present practice of having a steel inside finish involves considerable labor for its application and necessitates lining for seasonable climates and adds nothing to the strength of the car body as a whole.

Why the All-Steel Car?

Theories have been advanced that the ethics of the service demand an all-steel car. Why? In tunnel service the danger from fires is greater than from collision and the necessity for non-collapsible fireproof cars for such service is evident. On the other hand, the necessity for cars of this type is just as important for our long distance, high speed service, where luxurious buffet, dining, parlor and sleeping cars have provided comforts at the expense of increased weight. To meet the requirements of these fast schedules with heavy trains, the modern passenger locomotive of large tractive force has been developed. Considerations of safety demand that the passenger equipment of such a train be of uniform strength, capable of resisting the greater shocks in service and accident due to the greatly increased kinetic energy of the moving unit.

The past twenty-one years have demonstrated that all-steel cars may be modified to the extent of using wood in some form for the inside finish, without destroying the advantage a steel coach offers as a measure of safety.

The design of the saloon and lavatories should be simplified to be built either single or in combination with switch lockers and water coolers. The cost of manufacture of enclosures of this character, when they are made of steel and adhere to the finish required as part of the interior arrangement, is not consistent with productive methods now in vogue.

Standard Type Battery Boxes and Flooring

The size and type of battery boxes could be standardized, provided the size of batteries, irrespective of the system used, were alike. It is also considered good practice to have one size of battery box for all passenger cars, the size to be determined by the maximum number of batteries to be used on any one car.

Since the usual type of flooring consists of some plastic medium laid on corrugated, keystone or other forms of metal sheets, its life depends largely on the mixture. Wear in the aisle is inevitable and it is proposed to lay the width of the aisle separate from the rest of the floor by placing narrow strips of asphaltum between the aisle proper and the main floor. Such an arrangement will facilitate the re-laying and take care of expansion and contraction in a transverse direction.

Standard Methods of Painting

All railroads are interested in securing the maximum revenue from their equipment which technically, means no shopping. This introduces a problem of drying paint, which has not been given the attention that such a subject requires. Co-operation with the manufacturers relative to the introduction of a system that will minimize the time required for drying is desirable. Furthermore, it is not believed that the control of temperatures for air drying solves the problem from a productive standpoint.

Drying ovens are a necessity as the following figures would

†An abstract of Mr. Nystrom's paper was published in the March and April, 1924, numbers of the *Railway Mechanical Engineer*.

seem to indicate. This is the actual time for drying one coat only.

	Air drying time, hours	Oven drying time, hours
Primer	24	3
Putty and glaze	24	3
Surfacer	12	3
Color	24	3
Varnish	24	3

This system eliminates all weather conditions, extra pick-up work due to dirt or abrasions and provides for a continuation of the subsequent processes. Under present conditions air dried painting requires attention approximately every eighteen months, whereas with the oven the life and durability has been increased two and one-third times.

Importance of Proper Design

The success of any equipment depends on the design, but unfortunately the lack of time usually available between starting the design and the placing of an order has seriously hampered some designers. The resulting trouble in the shop owing to oversight in design, has given the subject a black eye on some roads.

It is unfortunate that the managements do not usually foresee the difficulties involved in such a problem, and allow at least a year to the designers to evolve a design which will not only be satisfactory for the initial order, but from which future orders of cars of different lengths and character can be constructed more expeditiously. The research work necessary to determine the possibilities of an all-steel equipment, for ease of manufacture and maintenance is enormous, but undoubtedly the labor thus spent is well repaid by the decreased cost of maintenance and interchangeability, so that after the first development any type of car can be designed at short notice with a larger degree of accuracy than has ever before been attempted.

The ideal car will never be built, but the lighter car of simple and easy, though sturdy construction that will carry the greatest number of passengers most comfortably on the least number of journals and always be ready to serve, is the type of car desired.

Application of Micrometers in Railway Shops

The Output and Quality of Work in the Car Shop is Improved by Their Intelligent Use

Part I

Railroads - Shops - Equipment

By M. H. Williams

In order that a man may work economically it is necessary to supply him with machine tools that are up to date in so far as design and strength are concerned and they should be kept in the best of condition. It is unfortunate that the railways are not always in a position financially to discard machine tools every time a more modern design is brought out by the manufacturers. It is, however, a very open question if, in most railway shops, money could not be spent to better advantage for the purpose of improving the minor devices, hand tools, gages, fixtures, etc., than for the modern machine tools such as lathes, planers, shapers and other necessary machines.

Proper Way to Apply Inside Micrometer Calipers When Measuring the Bore of a Wheel

The more advanced railway shops endeavor to arrange the work and supply measuring devices so that the machine operators do not have the occasion to leave their stations for the purpose of taking measurements. This makes it possible for the operators to increase the output by passing from one job to another with a minimum delay, and while the investment in the smaller devices is increased, the investment in the more costly machine tools is reduced because fewer are required.

Providing the necessary measuring equipment has made it possible to set limits or tolerances to govern the amount that should be allowed for the various grades of fitting according to the most modern practices. These limits should preferably be given in thousandths of an inch and are generally measured with micrometer calipers. There is no question but that limits should be set to govern the amount that should be allowed for drive and running fits for all motion parts of the locomotive. Without the use of micrometers and a few gages it is hardly possible to accomplish the desired results either when setting the limits or in the shops when working to them.

Measuring Car Wheels and Axles

It is estimated that 75 per cent of the new car axles turned and the wheels bored by car manufacturing concerns are measured with micrometers. Several railway shops are following this practice when repairing these parts. The general plan followed when repairing car wheels and axles in micrometer equipped repair shops are as follows. When

repairing the axles, the journals and the wheel seats are turned barely enough to remove the low spots and true the surface without respect to their diameters. The lathe hand rarely makes use of calipers when turning. The wheel seat is then measured, either when in the lathe or after removal, with micrometers similar in general design to that shown in Fig. 1. The practice is to measure each individual wheel seat at both ends and at the middle, thus making a total of six measurements on each axle. The average diameter of each is then marked with chalk on the axle adjacent to the seat. If the measurements made on a single wheel seat do not vary more than .004 in. the axle is considered satisfactory. If there is a greater variation, the axle is again turned. Owing to the large number of measurements that must be made in a day's work, attachments are, to good advantage, added to the regular micrometers in order to reduce to a minimum the time required for each measurement. These special micrometers shown in Fig. 1 are made up of the regular commercial article, to which is added the arm *A*, holding the squaring anvil *B*, which is set exactly square with the regular caliper anvil and screw. The gage points *C*, *D*, *E* and *F* are made so that the distance from the center line of the anvil and the screw is approximately equal to the radius of the axle to be measured. For a caliper having a range from six to seven inches, the faces of these points are spaced from the center line of the caliper frame 3 1/16 in., 3 3/16 in., 3 5/16 in. and 3 7/16 in. In order that these points will be properly located, each is provided with a spring detent that engages in a single conical hole drilled in the micrometer frame shown at *G*. When the desired gage point is moved to the proper location its detent drops into the conical hole which holds it in place. The purpose of these gage points is to insure the caliper being set so that the anvil and the micrometer screw will come central with the center line of the axle. When measuring an axle between 6½ in. and 6¾ in. diameter the gage point for that diameter is moved so the detent is in the conical hole. Placed on this size of axle with the gage

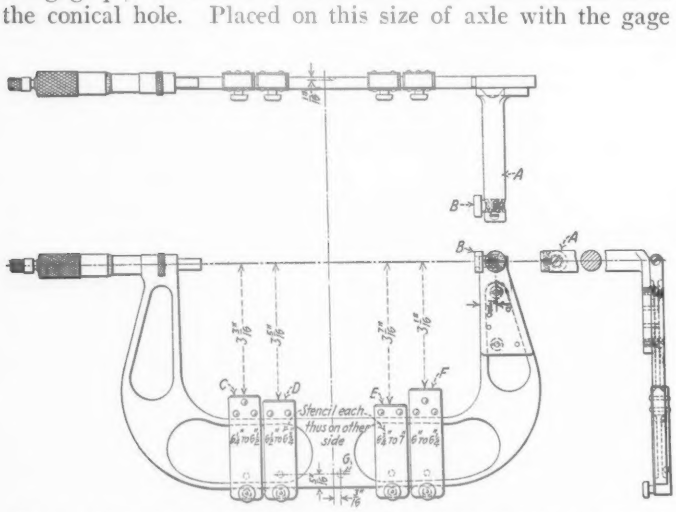


Fig. 1—Micrometer Caliper with Special Attachment for Measuring Wheel Seats on Axles

point resting against the axle at once sets the caliper so the anvil and the screw are practically in line with the center line of the axle. The possible error is about ⅛ in. on each side of the center line. The anvil and screw being each ¼ in. in diameter, this amount off center does not affect the measurements. This is illustrated in Fig. 2. Circles 6 in., 6¼ in., 6½ in., 6¾ in. and 7 in. in diameter are shown, each resting against the anvil *H*. Each circle also rests against one of the gage point surfaces.

A micrometer equipped with these gage points, in measuring eliminates all moving of the caliper up and down or feeling for the proper location. When measuring, the anvil and the squaring point *B* are held against the axle, also the gage points *C*, *D*, *E*, or *F* rest on the axle. Under this condition the caliper is located square with the axle, and the anvil and the screw are approximately in line with its center. Owing to this setting it is only necessary, when making a measurement, to turn the micrometer screw to the axle, remove the caliper and read the sizes. An inspector accustomed to the use of the caliper can readily make the six measurements required on one axle and also mark the sizes on each in ½ min., which will be found less than the time required measuring with machinist's calipers. The sizes marked with chalk on the axles are made use of when boring the wheels.

Advantages of Micrometer Calipers

There are four principal advantages in using micrometer calipers as compared with machinist's calipers or snap gages. These are the general toning up of the shop, the superior fitting of the axles in the wheels, less time required to caliper, and time saved when boring the wheels. We will now consider these points in the order mentioned.

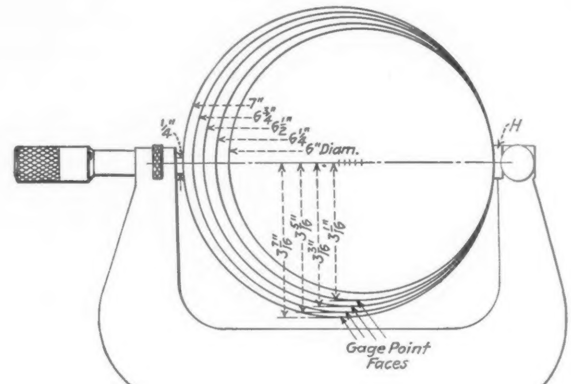


Fig. 2—Diagram Showing How the Anvil and the Screw of the Caliper Are Practically in Line With the Center of the Axle.

Toning up of the shop—Calipering and measuring each wheel seat at three points with micrometer calipers, at once shows up defects in turning or defects in the axle lathes. These machines receive very hard usage owing to the low cost of doing this work and the large output demanded. The wear on the bed or ways must, of necessity, be excessive, especially where the journals are burnished. This is very undesirable owing to the possibility of not fitting the wheel in a proper manner. A taper or irregular wheel seat will not make a proper force fit in a wheel that has been bored straight.

To turn each wheel seat to an exact diameter from end to end adds greatly to the costs and is a refinement which in the light of past experience is not warranted. There is, however, a limit of taper that can be allowed which in a number of shops has been set at .004 in. That is, one end of a seat may be .004 in. larger than the opposite end, which is considered perfectly safe for cast iron wheels and in most cases for steel wheels, although a closer limit is desirable for the latter. Measuring each axle with micrometers as it comes from the lathe at once shows if the turning has been done in a proper manner. If not turned within the limits it goes back for another turning. Under this condition the lathe operator knows just what he must do and the question of individual judgment between the lathe operator and the person inspecting is entirely eliminated.

Another point enters here. As previously mentioned, axle lathes are subject to excessive wear and are liable to get out of true, or the lathe centers may become worn. Either condition may cause defective turning even where the operator uses ordinary care. Where a number of defective wheel seats are turned on any one lathe it should be examined for possible inaccuracies. This is readily done by taking a light cut

over a wheel seat or journal without changing the adjustment of the turning tool during the turning operation, and afterwards measuring with micrometers.

It can readily be seen that this toning up of the shop which will follow with the use of micrometer calipers will make it difficult for a defective wheel seat to get out of the shop and as a result there will be a minimum number of wheel failures to explain.

Superior fitting of axle wheel seats in the wheel—This is a question that hardly calls for explanations. Every wheel shop foreman knows that the wheel seats will fit the wheels more perfectly with less liability of coming loose or bursting the wheel where the seat is practically of one diameter from end to end. The use of micrometers will bring about this result.

Less time required to caliper—Experience has shown that wheel seats are measured in less time with micrometers than with machinist's calipers. However, the question of time is of secondary importance. The principal advantage is gained from the fact that the exact diameter is at once shown by the micrometer and can be marked on the axles, this diameter being made use of in boring the wheels.

Micrometers for Measuring Diameter of Wheel Bore

Time saved when boring wheels—Car wheels should be bored of one diameter from end to end of the bore. This is a condition readily obtained with the modern double-bit adjustable boring bars having micrometer dials such as are now on the market. These bars are so perfected by the use of micrometer dials that car wheels are readily bored to the required diameter within a limit of less than .001 in. However, the cutting tools in these bars will wear, which makes it necessary to check the size of each wheel bored with micrometers. This measuring is quickly and accurately made with the inside micrometer caliper shown in Fig. 3. It is made up of an ordinary commercial inside micrometer shown at *A* which fits loosely in the base *B*. When measuring the diameter of a wheel bore, the base *A* is held against the bore which lines the micrometer square and central with the bore. It is then only necessary to turn the micrometer screw out to the bore size, remove and read the size. This eliminates side and end feeling which results in accurate measurements being made in a few seconds.

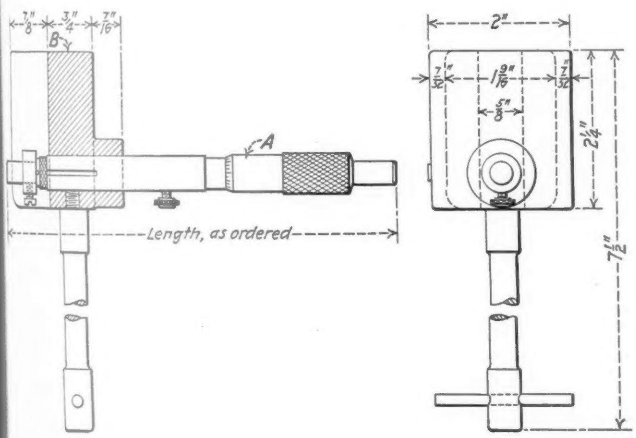


Fig. 3—Inside Micrometer Calipers with Special Attachments for Measuring Wheel Bores

Micrometer Calipers Eliminate Errors

In order to bring out the advantages of the outside micrometer and the inside caliper a brief description of the process of wheel boring will be given. Mention was made of marking the diameters of wheel seats on the axles. It is the practice in a number of shops to make a memorandum of the sizes marked on the axles. This memo is then handed to the car wheel boring mill operator who bores the wheels, starting at the top of the list and going down. Each wheel is bored a certain number of thousandths smaller than the sizes shown. The operator marks the finished diameter on each wheel, after which the wheels and axles are paired and mounted. The practice when boring is generally for the operator to measure the size of the bore of the wheel with the inside micrometers and make a note of the micrometer dial on the boring bar. The reading of the micrometer and the boring bar dial rarely agree, but the operator notes the difference in the two readings and makes the proper allowances. That is, if the measurement of a trial wheel bore is 6.650 in. and the bar dial .075 in. the operator understands that the dial should be set .025 in. high in order to obtain the correct size. (The bar dials generally only read to .1 in.) After ascertaining the correction to be made, it is only necessary to turn the dial to the required size previous to boring the wheel. After completing the finishing cut, the wheel bore is measured with the inside micrometers, this, in every day practice, being the only measurement made of the wheel bore. The measurement of the wheel is a continuous check for the correctness of the boring bar dial and the wear of the cutters. If the readings are low, showing wear of cutters, a greater allowance is made for the bar dial, which in place of .025 in., as mentioned above, may be increased to .026 in., .027 in., etc. With the recently designed boring bars having one set of cutters for roughing and a second set for finishing, the wear on the finishing cutters is slow and readjustment of allowances are not frequent.

If the size is found to be what is desired, the diameter of the bore is marked on the wheel and the wheel is removed from the boring mill. Should there be an error, the wheel is rebored for an axle having a larger wheel seat. It is also customary to measure the bore from end to end in one out of every 100 wheels to detect possible errors that may be caused by a defective boring bar or boring mill. A boring mill operator who is accustomed to the work may readily bore 95 per cent of the wheels to the desired diameter at first trial.

These micrometers at times get out of adjustment and should be frequently checked to the master standards which are supplied by the manufacturers of these instruments.

The advantages of this method which have been made possible owing to the use of micrometer calipers and the modern boring bars are at once apparent. Compare it with the older plan of calipering each axle with machinists' calipers, then setting a second pair of inside calipers to the first set and making allowances for the amount the wheel seat should be larger than the bore and possibly making a number of trial bores to see if the cutters are set for the correct size. It is a case of exact methods with micrometers versus hit or miss methods with the machinist's calipers.

The following questions may be raised as to the effect of the use of micrometers in a car wheel and axle shop.

1.—Can the general run of men employed in the shops make the proper use of micrometers?

2.—Will the men exercise reasonable care in their use?

3.—What will be the effect on the men?

4.—What will be the effect on the output?

5.—What will be the effect on wheel mounting pressures?

6.—Will time required to measure be reduced?

7.—Will the costs of micrometers and the upkeep be excessive?

The questions, after carefully studying the problem, are readily answered.

Men using micrometers.—As a general proposition, the men who have been brought up in car wheel and axle shops do not understand their use. However, very few men will be found in any railroad shop who do not have the necessary intelligence to master micrometers in a few days. Generally

when teaching their use, it is advisable to explain their principles and then allow the men to measure several articles, allowing a reasonable amount of time for acquiring the necessary practice and for the newness to wear off. Where it is understood that they must be made use of, the men acquire the knack of measuring and reading sizes and soon become very quick and proficient.

Will the men exercise reasonable care in their use?—The answer is decidedly yes. Workmen when given good tools want to keep them in good order. As proof of this, it is well to note the care taken by the workmen of the machinist's calipers, steel rules and similar tools.

What will be the effect on the men?—Workmen in practically any shop wish to do their work right. A man turning axles or boring wheels is just as proud of doing his work up to the standards demanded for his particular line of work as the man who does the finest kind of work to the standards which may call for the greatest possible accuracy. Where limits are set in thousandths of an inch to govern the amount a wheel seat or a wheel bore may be tapered, the workman knows the amount of leeway he has to go on and works accordingly. When there is a dispute between the workmen and the party passing on the acceptance or rejection of a piece of work, the limits of diameter which are readily measured with micrometers practically settles the question, thus eliminating the personal equation and a lot of ill feeling. In actual practice it is generally found in a micrometer equipped shop that the workmen are very proud of work well done and will invite the inspector to measure their work with micrometer in order to show their superiority. This is a spirit the value of which would be hard to estimate.

What will be the effect on the output?—Turning repaired axles to the largest diameter to which they will true up, means cutting away the least possible amount of metal and consequently prolongs their useful life. This results in a saving when compared with the practice sometimes followed by turning to snap gages or step sizes. The turning of axles just sufficiently to true up without regard to sizes reduces the time of turning to the lowest limit. In the case of new axles, they are turned within a reasonable shop limit that can without detriment be .005 in. plus or minus the size called for on the drawings.

These methods take the responsibility of the fit of the wheel on the axle entirely away from the lathe hand and put it on the boring mill operator, which in the light of experience, is the proper thing to do. To turn an axle to a limit of .001 in. which is necessary in order properly to press it into previously bored wheels is a slow and more expensive operation. To bore a wheel to this limit with a modern boring bar does not take any longer than simply boring without respect to size. The practice is when boring, to set the micrometer dial of the boring bar about .040 in. small and rough bore, after which the dial is set to the size required for the finishing cut and finish bore. The required size of the wheel bore is thereby obtained to the limits of .001 in. in two passes of the boring bar, which are generally conceded as being essential in order to obtain a true hole. The boring bars have one set of roughing cutters at the lower end and a set of finishing cutters mounted higher up. With this combination the boring operation is practically continuous which reduces the time required.

Another point well worthy of careful consideration is the question of wheel mounting. The use of the micrometers insures the wheel seats being turned to practical limits from end to end. Likewise, the wheel bore will be practically of one size from end to end. When mounting, the wheels will have an equal bearing throughout their length which, as well understood, is a desirable and safe feature.

Wheel mounting pressure.—The use of micrometers makes it comparatively easy to bore the wheel a predetermined amount smaller than the wheel seat, the exact amount of difference between the two having a number of variables that can only be found from trial mounting and experience. However, the exact amount of this difference when once ascertained is followed until conditions of the wheels or the axles change. Cast iron wheels from different foundries differ in mounting pressures even when bored allowing the same difference in diameter between the axle and the wheel. As a general proposition it will be found that cast iron wheels having a seven-inch bore, when bored .015 in. smaller than the axle wheel seat, will mount about 60 tons, and a steel wheel of the same size of axle when bored .007 in. smaller than the axle will mount at about 80 tons. However, the conditions are governed by the make of wheels, kind of lubricant used on the axle when mounting, smoothness of turning and boring, etc.

Time required when taking measurements.—In answering this question it is well for the purpose of comparison to take into consideration the practice with machinist's calipers. The latter must, from necessity, be set for each individual wheel seat, afterwards an inside caliper is adjusted to the first pair at which time allowances are made for the amount the wheel seat is larger than the wheel bore. When boring, one or more trials are made before the cutters are set to the correct size. Where the wheels are first bored and the wheel seats afterwards turned to a suitable diameter for the wheel, the practice is reversed. Either practice makes it necessary for the workman to travel from the axle pile to the boring mill for each wheel passing through the shop which not only consumes the workman's time, but, in addition, reduces the output of the boring mill. With the use of micrometers, in the larger shops, all wheel seats are measured by one man who is assigned for that purpose who checks for the amount of irregularity or taper and also chalks the sizes of the wheel seats on the axles and in addition makes a memorandum of these sizes, which is handed to the boring mill operator who bores to the sizes indicated. Under this condition the boring mill operator need not leave his station or delay the output for the purpose of taking measurements and as a result the output per machine is increased.

In the smaller shops where an inspector is not warranted, the axles are turned and laid on the floor, the boring mill operator then measures the wheel seats of a number of axles one after the other and makes a memorandum, the only delay to the boring mill being the time the operator is away to make the measurements. In other words, the measurements are made all at one time in place of traveling from machine to axle for each wheel seat, which is required when using machinist's calipers.

Is the cost of micrometer calipers excessive?—In a large wheel and axle shop, say where 15 axle lathes and four boring mills are employed, the following outside micrometers would be required:

No. of calipers required	Outside range From	To
1	4 in.	5 in.
2	5 in.	6 in.
2	6 in.	7 in.
1	7 in.	8 in.

The cost of the micrometer averages about $9. The attachments as shown in Fig. 1 will add approximately $15, or say $25 per micrometer, which makes $150 to equip the shop.

The following inside micrometers would be required:

No. of calipers required	Outside range From	To
1	4 in.	5 in.
4	5 in.	6 in.
1	6 in.	7 in.

The average cost of the bare micrometers is about $4.00 each, and the squaring block about $10, or for each caliper about $15. This makes about $90 to equip the shop. The above, with such master standards as should form a part of the equipment, will bring the total cost up to approximately $250 for a shop of this size. The cost of the equipment for a

shop employing six lathes and two boring mills would be about $150.

Experience has shown that the cost of upkeep of micrometers is low. They must be checked to master standards about twice a week owing to possible injury from falling or being accidentally hit. However, it is safe to assume that the cost of upkeep in a shop of this kind will not exceed $25 a year.

When considering the safety of the force fit of the wheel on the axle owing to the more uniform bore of the wheel and turning of the wheel seats, the time saved by the workmen when measuring wheels or axles and the general toning up of the shop, the use of micrometers becomes a paying proposition.

An an illustration of the possible speed when boring cast iron wheels such as used for new or repair work, in one shop where two of the most modern car wheel boring mills have been installed, which are equipped with adjustable boring bars having micrometer dials, separate roughing and finishing cutters and a radius tool for forming the fillet, these two mills are operated by one man who bores the wheels to sizes shown on memorandums within a limit of .001 in., places the wheels in and removes them from the mill at the rate of 10 per hour. This high output is made possible largely owing to reducing the calipering time. The machine work is not delayed in the least for the purpose of making measurements.

Recent Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Bill for Repairs Should Agree with the Defect Card

On June 14, 1920, the Atlantic Coast Line repaired the Atlanta, Birmingham & Atlantic car No. 25075 at its Florence, S. C., shops. A joint evidence certificate was furnished by the owners which showed that two wooden draft timbers were used instead of Bradford metal arms and Miner draft rigging was used instead of Bradford draft rigging. On December 11, 1920, the Atlantic Coast Line issued a defect card for these two items and marked the defect card "Labor only," in accordance with Rule 88. The Atlanta, Birmingham & Atlantic did not object to this card but rendered its bill amounting to $31.21 to cover the repairs. The repairing line found an error in this bill that amounted to more than 10 per cent of its total and it was therefore returned to the owners on February 10, 1921, for correction. The owner instead of making the correction, issued a counterbilling authority which covered the entire charge against this car and rendered a subsequent bill amounting to $192.30, for both labor and material. The Atlantic Coast Line returned this bill stating that the defect card did not cover anything but the labor. The owner, however, claimed to have a recent interpretation which showed this charge to be correct and it quoted the following abstract from a letter from the Secretary of the Arbitration Committee dated January 31, 1921, which read as follows: "Rule 95 contemplates that missing friction draft gear shall be replaced by the repairing company for a charge for labor only, and rule 88 contemplates that the owner is entitled, on presentation of joint evidence, to defect card for a wrong draft gear applied on the authority of which it may make charge for correction." It was claimed by the repairing line that the Bradford draft gear is not a friction draft gear and therefore, this opinion had no bearing in this case.

The Arbitration Committee rendered the following decision: "Under Rule 88, 1919 Code, the Atlantic Coast Line defect card for labor only for correcting the wrong draft gear arms, is all that can be asked of the Atlantic Coast Line for this item.

"The Atlantic Coast Line billing repair card shows that the coupler, draft gear and yoke were missing and, according to Rule 95, these parts, when missing complete, must be assumed to be in good order. The Atlantic Coast Line defect card should, therefore, be issued for the material of draft gear and yoke and the labor of riveting the yoke, if necessary."—*Case No. 1295, Atlanta, Birmingham & Atlantic vs. Atlantic Coast Line.*

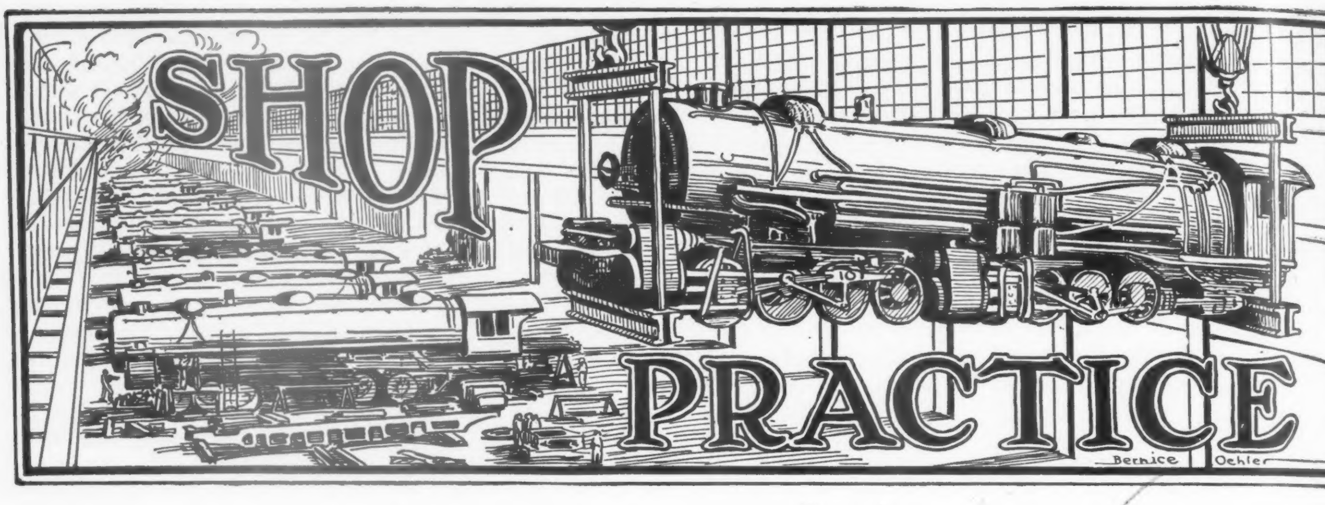
Car Burned While in Interchange

The New York Central box car No. 161091, loaded with charcoal, was placed by the Louisville & Nashville on the interchange track at East Birmingham, Ala., at 12:30 p. m., April 17, 1920, for delivery to the Southern Railway. The car was inspected by an inspector, who is employed jointly at that point by both the Southern and the Louisville & Nashville. It was found to be in good condition for acceptance in interchange, however, no billing accompanied the car and therefore, it was tagged to be returned to the Louisville & Nashville for proper billing. About 4:00 a. m., April 18, 1920, this car was discovered to be on fire by a passing train crew. The city fire department was called but before the fire could be extinguished the car and contents had been considerably damaged. The contents were salvaged by an agent of the Southern, after which the car was switched back and forth between the Southern and the Louisville & Nashville, neither of whom would acknowledge possession. The car remained on the Southern shop yards while the matter was being handled by representatives of the Insurance and Transportation Departments of both roads to settle the question of possession and also to place the responsibility. Repairs were finally made by the Southern at a cost of $683.08. Efforts were made by that company to have the Louisville & Nashville assume all responsibility for the damage from the fire. It contended that the car was not in its possession within the meaning of rule 6 of the Car Service Code and also this rule had not been complied with, which requires that the billing precede or accompany the car when it is being moved from the interchange tracks. The Louisville & Nashville claimed that Rule 6, of the Car Service Code, should not decide which line had possession of the car. And as the car had been duly inspected and accepted by the Southern Railway inspector under the A. R. A. Rules of Interchange it was contended that the car was in the possession of the Southern at the time of its destruction.

The Arbitration Committee made the following decision: "The Southern Railway is responsible for the damage to this car. Decision 1254* applies."—*Case No. 1296, Southern Railway vs. Louisville & Nashville.*

*Case No. 1254 was abstracted in the August 1923 number of the *Railway Mechanical Engineer*.

Bulletin No. 7 has been issued by the Railway and Locomotive Historical Society, 6 Orkney Road, Brookline, Mass. This number consists of about 75 pages and is full of interesting matter. The longest article is on early locomotive building in Lowell, Mass., a paper read by Edwin R. Clark before the Lowell Historical Society. This paper summarizes a large amount of research, the author having gone through the records from the beginning of the nineteenth century. He gives interesting notes concerning George Brownell, Nathan Appleton, Zerah Colburn, Walter McQueen and Wilson Eddy. Other papers deal with the locomotive history of the South Carolina Canal & Railroad Company, the Louisville & Nashville and the Central Pacific.



Railroads

Some Questions in Modern Shop Design

Flexibility of Arrangement with a View to Probable Future Expansion Is an Important Consideration

By E. Wanamaker
Electrical Engineer, Chicago, Rock Island and Pacific, Chicago

APPARENTLY the trend of today in railroad shop design is along such lines as will assure both better work and greater shop efficiency. At the same time we must not lose sight of the fact that it is necessary to keep the shop fixed charges as low as possible. It is therefore highly important that the first cost of land, buildings and machinery be held as low as compatible without lowering the shop efficiency or affecting the quality of the output. Therefore, we are as a rule led to the establishment of one or more main shops and in the case of large railroads, as many smaller shops as may be necessary economically to expedite locomotive maintenance and repairs.

Good business demands that shops and engine houses should be so designed today as to be economically serviceable 30 years hence, and should also be designed in such a manner as to permit an increase in capacity from time to time without lessening or decreasing the net efficiency. The locomotives to be repaired in the future may be steam, electric or internal combustion engine drive, or any combination of these types, and again each of these classes may have various sub-divisions of types or classes. This fact should be borne in mind when the design of new shops and engine houses is under consideration.

To accomplish the desired results, a system design as a whole should be worked out and a program adopted such as will guarantee constantly increasing efficiency and economy during the succeeding years, rather than decreased efficiency and economy.

Shop Location

With due consideration being given to the economic location as regards distribution of power, labor market, cost of real estate, etc., it may be found that on a small road one main shop and several modern engine houses will be sufficient to meet all requirements, while larger roads may require one main shop and several small shops, while still larger roads may require two or more main shops and several small shops.

It goes without saying that time and labor saving devices are a necessity today in both shop and engine houses, but sad to relate, few railroad mechanical departments have been able to secure sufficient modern facilities. Then, too, it must be borne in mind that modern ability and skill are necessary in both officers and men if efficient use, with resultant economy, is to be obtained from such modern facilities. Briefly, modern skill and ability are as necessary today as modern facilities, to economically maintain the steadily increasing technical complications in the modern locomotive equipment, together with the steadily increasing technically complicated machinery for maintaining such locomotives. Indeed, it seems even more difficult to obtain modern men than to obtain modern facilities.

Comparing the cost of motive power with the cost of modern shops and engine houses, it seems that we are not justified in operating shops and engine houses that are not at least being gradually modernized by following a well-planned program. A shop having a capacity of say 12 or 15 locomotives a month can as well be modern as a shop having a capacity of 25 or 50 locomotives a month. As a matter of fact, the cost of supervision is probably lower, and the efficiency of the workmen better in a small shop than in a large one. As a rule, however, the heavy back end or firebox work is best confined to a main shop and, preferably, to a large main shop.

Layout of the Main Shop

It is felt by many that large railroads should have at least one locomotive production shop—that is, a shop doing no shop order or manufacturing work—such work to be performed preferably in a shop devoted to manufacturing only, or perhaps making repairs to work and maintenance of way equipment as well. The rest of the shops might well and economically handle some such work along with their regular locomotive work. A careful study is necessary to decide this problem.

There are several general plans or designs which must be considered before any of the detail designs can be given consideration.

First—Shall the shop be under one roof, or shall it be divided into several buildings?

Second—Shall the locomotives for repair be placed longitudinally in the erecting shop, transversely, or on an angle?

Third—Shall cranes or hoists be used for wheeling and unwheeling locomotives?

In this connection, it must be decided whether a locomotive is to be moved progressively through the shop, or whether it is to be unwheeled, repaired, wheeled and finished on one pit or blocking location. The stripping and finishing pits may or may not be the same, depending on the general design of the shop. For a shop having a capacity of 25 locomotives or more a month, there is much to be said for a design embodying the use of cranes for handling the locomotives. For a shop with a capacity of 12 or 15 locomotives per month, there is much to be said in favor of locomotive hoists, and the use of a transfer table.

Just here it might be well to say that a locomotive shop or enginehouse should be laid out with respect to the work to be done and the building then formed around the shop itself, considering that the building is not the shop but only an envelope covering the shop. This is especially true when we pause to consider that the shop or enginehouse should be one that can be economically used 25 or 30 years hence.

When locomotives were small and the Stevenson valve motion was standard, it was necessary to have a pit under each locomotive. Today with our large modern power with outside valve gear it would seem that the necessity for pits has disappeared, except for stripping, wheeling or finishing locomotives. This will apparently hold true for any shop where the stripping and finishing is done on separate pits from the blocking locations.

Description of Proposed Shop Layout

The following is a brief description of a proposed shop having a capacity of 15 locomotives a month of average size, with probably 12 locomotives capacity a month for larger power, the only pits to be those constructed for stripping and finishing or wheeling, located in the same end of the erecting shop. The remaining portion of the erecting shop is to be used for engine blocking locations, preferably arranged in a longitudinal manner, with the engines so blocked that they can be set close together, end to end, at a sufficient angle from the longitudinal shop center line to permit easy flue replacements. The relative capacity and exact location of stripping and erecting pits to each other, and to the blocking locations, depends upon the final conclusion reached after detailed study.

It would seem that the greatest flexibility and capacity can be thus secured, especially so when various classes and sizes are to be shopped simultaneously, as this will enable the utilization of space to the fullest capacity and greatest advantage from both efficiency and production standpoints. Such an arrangement will in all probability enable the shop to handle successfully any size or type of motive power that may be developed within the next 30 years.

Locomotives should be blocked sufficiently high to eliminate the necessity for pits. Suitable floor drains and traps should be provided for draining boilers on test, etc. In this way the erecting floor space can be kept filled, regardless of classes of locomotives on the locations, which is not true where the herringbone arrangement of pits or transverse pits is used. Two cranes in the erecting shop bay can easily handle all locomotives and at the same time with auxiliary hoists sufficiently serve all operations for which cranes are desirable.

It will be here noted that this particular proposal includes cranes for handling the locomotives in the erecting shop and is therefore called a crane erecting shop design. It should be borne in mind too that a well designed shop using locomotive hoists and pitless blocking spaces might prove a still better design for the small shop. In such a case pits or blocking spaces or locations should be equipped with track rail so that shop trucks may be used for moving locomotives to and from hoists and pits or blocking locations. A transfer table and transverse locations or pits then become desirable if not necessary. It is felt by many, however, that the large shop—25 to 50 or more locomotives capacity—could only be well designed by making use of locomotive handling cranes for the erecting shop.

In our proposed shop the heavy machine shop tools, wheel lathes, etc., can be so located in the machine bay alongside the pit end of the shop as to necessitate a minimum movement or transfer of heavy parts to be machined.

In the boiler and tank shop bay, the heavy boiler work can be handled with greatest efficiency by locating such work opposite the pits, leaving all of the lighter boiler work and flue shop work for the middle section of the bay, with the tank and cab work for the far end of the boiler and tank shop bay, with service tracks entering doors at that point. By such an arrangement, ample space and service can be provided for trucks, stokers, boosters, feed water heaters, pumps, etc., that may be a part of the locomotive.

The general design calls for practically three shop divisions—a center bay erecting shop, one side bay for the boiler and tank shop and the other side bay, for the machine shop. It might be advantageous to install a comparatively narrow gallery or mezzanine floor next to the outer wall of the machine bay, for handling all of the light locomotive equipment, such as lubricators, injectors, electrical equipment, gages, etc.

If available funds are short, cranes in the boiler and tank shop and in the machine bay, could be installed at a later date than the initial installation; in such case it would be necessary to have an inexpensive elevator for handling the light material to or from the gallery or mezzanine floor. The shop supervisor or foreman's office, might well be located on such a gallery.

This type of shop seems to lend itself to an extension or increase in capacity at any time without decrease in shop efficiency or increase in shop unit construction cost. Detailed study will probably suggest that either one or both end walls of the shop should be of a comparatively temporary nature, so that they can easily be moved in case of shop extension. The type of building necessary to house such plant will in all probability be lower in cost than any other type for a modern shop, considering the cost of a transfer table of ample capacity, in case a transverse pit shop is considered.

Provide Cleaning Facilities Outside of Shop

Study of the possible methods of cleaning locomotives before entering the shop, indicates that the sand blast method used on the outside of the shops or possibly located in a shed built adjacent to the locomotive entrance doors of the shop and over the incoming tracks, will prove the most economical and at the same time the most desirable. That part of the incoming track on which the locomotives are to be cleaned, should have a concreted basin underneath, to catch all of the sand and drain it into a receptacle or receiver from which it can be moved by air pressure to be again used in the sanding nozzle, thus using the sand over and over until such time as it loses its sharpness, when the sanding equipment can be recharged with new sand. It seems that if such a cleaning arrangement is properly installed and handled, the locomotive will go into the shop thoroughly cleaned, making it easy to locate possible fractures, etc., at the same time making it much more pleasant for those who handle the various parts, as well as increasing the speed at which they will handle them. At present it seems that a close check will in all probability indicate this

to be more efficient and more economical than the lye vat process or any other available method of cleaning.

Arrangement and Equipment of Pits Important

In considering the design for stripping and finishing pits in the shop, it would be well to consider having the rails supported on pedestals with a complete open pit underneath and with manways and steps conveniently located for entering or leaving pit, and some form of removable floor boards for roofing over the pits at such times as openings through the floor are not necessary or desirable.

The electric light and power receptacles should be conveniently located under the pits for plugging in portable electric lights and motor-driven portable machinery. Permanent lights should be installed in recesses in and under the pit with reflector used to project the light where needed.

One advantage of the pitless arrangement of the erecting shop lies in the ease with which it is possible to thoroughly clean the shop floor each night, washing down with a hose if deemed desirable.

The longitudinal aisle between the blocking locations should be such that locomotives can be moved up and down the shop without having to carry them over those on blocking locations, and sufficient room should be left around the locomotives for placing the parts for re-assembling. There should be sufficient room left throughout the entire shop for operation of power-driven trucks for handling material.

It would seem that a shop embodying these principles of design can be used for shopping miscellaneous forms of power such as are in use at the present time, and in fact could be made to successfully handle internal combustion motor cars and locomotives and electric locomotives, as well as the various types of steam locomotives that may be used.

Should such a shop as this have its capacity increased to say 40 or 45 locomotives a month, due to increase in business in that particular shop territory, it might be possible to increase the shop capacity by way of double ending, that is, working locomotives in and out from each end, or doubling equipment at each end, with some changes in the equipment in the intermediate section of the shop. It is realized, of course, that for electric locomotives or internal combustion locomotives, it would be necessary to change the machine tool arrangement, but in no way would it be necessary to change the general arrangement of the shop and buildings.

It is probable that the chief advantage in a pitless shop at the present time lies in the better utilization of small space and volumetric dimensions combined with the flexibility of the shop as regards capacity and future requirements.

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machines

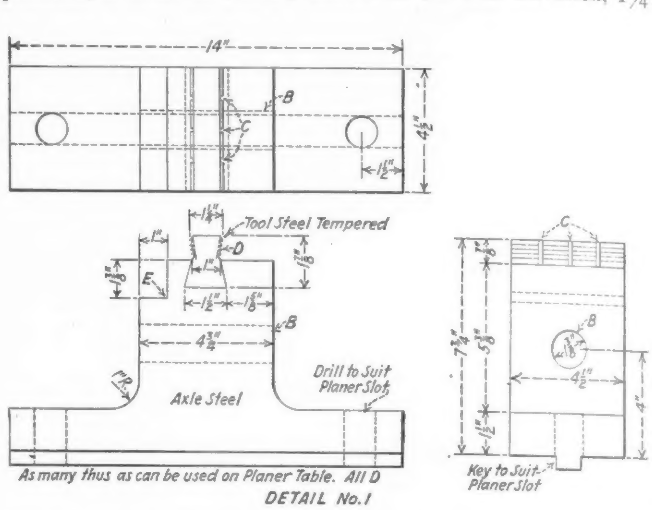
Driving Box Shoe Planing Device

By J. D. Snyder

A DEVICE for semi-finishing driving box shoes or both shoes and wedges, for placing in stock, is shown in the illustrations. By means of this jig the shoes are planed on all surfaces except the box face at one set up. This side is left unfinished until ready to be used for repair work.

The device consists of a number of fixtures as shown in detail No. 1. It is made of steel or wrought iron, drilled for tee head bolts to suit the slot in the planer table and is also drilled at *B* to receive the tie rod *F*. A tongue is also required on the bottom to suit the slot in the planer table. The tee head bolts and tongue should be a sliding fit in the slot to permit longitudinal motion when the bolts are loosened. At the top of the fixture a piece of tempered and roughed tool steel *D* is dovetailed in. The slots *C* are for the purpose of preventing lateral motion of the shoes. At *E* a step or off-set is cut out for use when both shoes and wedges are planed. The wedge-bolt end of the casting is placed on the step as shown in Fig. 2. Liners may be placed under the ends to secure the proper taper. The fixtures should be placed on the table in such a position that the tool will start cutting at the wedge bolt end of the casting.

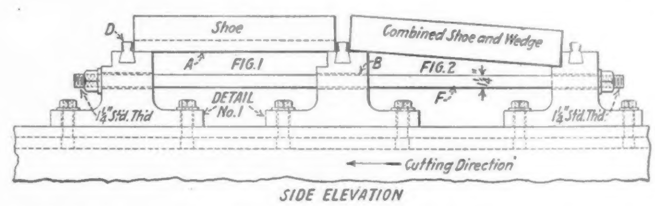
After mounting as many fixtures on the planer table as possible, a steel tie rod *F*, shown in the side elevation, 1¼



Fixture for Holding Driving Box Shoes Rigidly on Planer Table

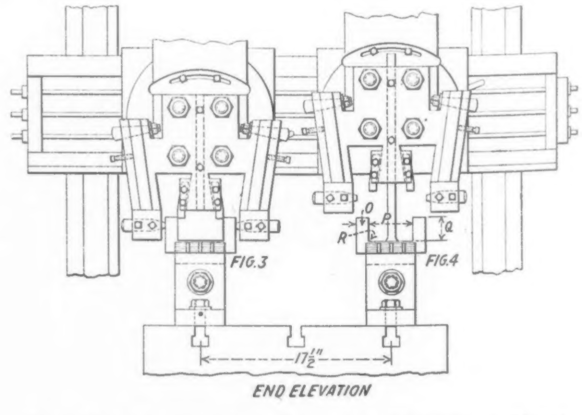
in. in diameter and threaded at each end, is run through the hole *B*. This will tie together all the fixtures on the table bed. The shoes are then placed in the fixtures and held rigidly in place by drawing up the nuts on either end of the tie rod.

The tool holder consists of the body shown in detail No. 7,



Method of Fastening Fixtures on Table and Holding Shoes Firmly in Them

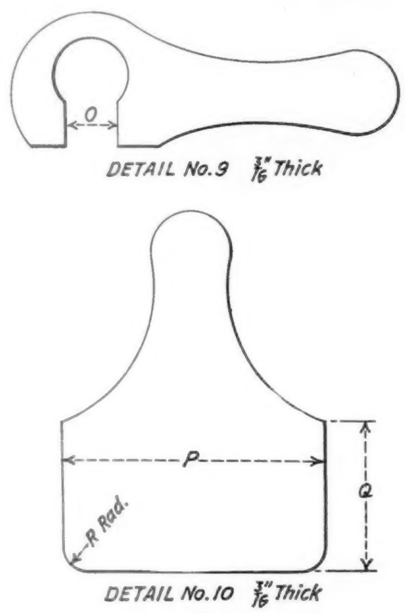
having two slots machined in it at *X* to receive the tools X^1 (see the plan view), which are of ⅞-in. square material. They machine the inner sides of the shoe. The long slot *Y* receives tool Y^1 which is of ¾-in. by 1½-in. material. The tool machines the inside bottom surface of the shoes. The two slots at *Z* receive detail No. 8 which is the holder for tools W^1 which are of 1 in. sq. material. These tools machine the outer sides of shoes. These holders are placed



General Arrangement of Tools and Fixtures on Planer

Locomotives - Driving box shoes

at an angle of eight degrees so that they will swing away from the shoes when the planer reverses. The tool holder detail No. 8 is drilled and tapped at 3^1 for a screw, detail No. 3, which holds the tool W^1 in a slot W. It is also drilled and reamed at 4^{11}, and detail No. 7 at 4^1 for the taper bolt,



Gauges for Determining Thickness and Contour of Shoes

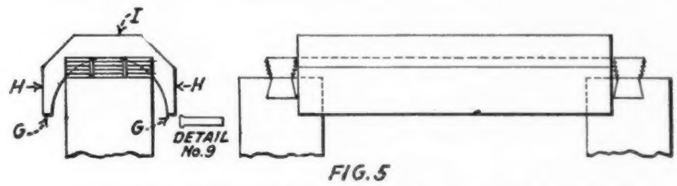
detail No. 4. This bolt is tapered to permit taking up the wear which assists in preventing chatter.

Detail No. 7 is drilled at 5^1 for a set screw, detail No. 5, which keeps detail No. 8 a snug fit and also assists in preventing chatter. It is also drilled and tapped for a set screw, detail No. 6, which is used to hold the tools X^1; for another, detail No. 2, to hold tool Y^1. It is drilled at V for a stud which holds it to the planer apron block.

The tool holder is mounted on a regular planer apron block. Tools W^1 and X^1 are inserted the proper distances apart. Tools X^1 are inserted in such a position that when tools W^1 are at the bottom of the outer sides of the shoe tools X^1 will be at the bottom of the inner sides. The tool holder is then raised high enough for the ends of detail No. 8 to clear the top of the shoes. Tool Y^1 is then inserted in slot Y and the inner bottom of the shoe is finished.

The tool holder shown can be used for shoes for all locomotives except the heaviest types. For the heavier types use the chart showing dimensions A, B, C, and D.

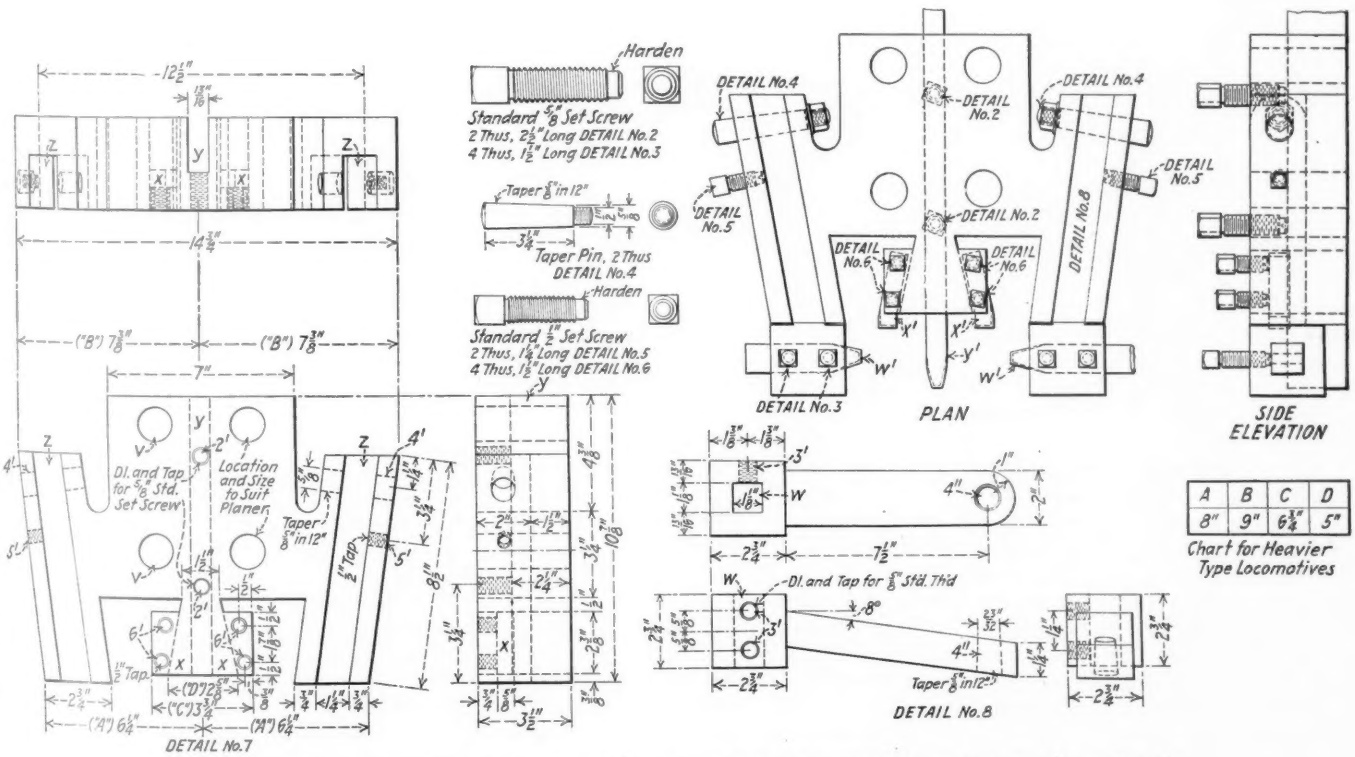
A caliper gage as shown in detail No. 9 is used for gaging the thickness of the sides of the shoes. Detail No. 10 shows a gage used for the inside contour. The dimensions P, Q



Fixture for Machining Engine and Trailer Truck Box Shells

and R on the gage correspond to the same dimension shown on the shoe in Fig. 4.

While originally designed to facilitate the planing of driving box shoes, these fixtures and tools can also be used to good advantage in machining engine and trailer truck box shells. For this work the rough castings are placed in the fixtures as shown in Fig. 5 and tightened the same as the driving box shoes. The tools X^1, which machine the inner sides of the shoes are removed and the tool Y^1 which machines the bottom of the shoes is used to finish the surface I. The tools W^1 which machine the outer sides of the shoes are set the proper distance apart to machine surfaces H^1.



A	B	C	D
8"	9"	6¾"	5"

Tool Arrangements for Planing Driving Box Shoes on All Sides Except the Box Side with One Set Up

The swinging tool block is then raised and secured in this position by filling in behind it. The tool holders, detail No. 8, are also fastened rigid by set screws, detail No. 5, and the tools shown in detail No. 9, are inserted to machine the surface G, by moving the planer heads on the cross rail.

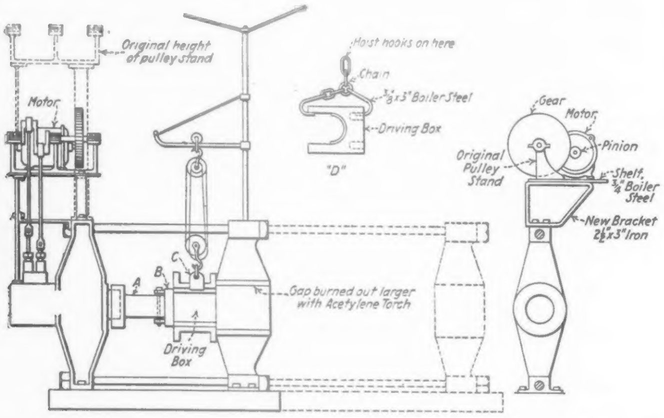
Locomotive shops – Equip

Truck Wheel Press Converted Into a Driving Box Press

By V. T. Kropidlowski

WHEN a new 400-ton hydraulic truck wheel press replaced an old 150-ton press, it was decided to recondition the old machine for use in a small engine terminal shop as a driving box and rod brass press. To save floor space, it was reduced from the length shown by the dotted lines in the sketch to a length more suitable for the smaller work. The same end resistance post used on the truck wheel press was utilized on the new machine on account of the fact that the center post was a hinged post and could not be bolted to the bed plate.

By referring to the sketch, it will be noted that the hydraulic pumps were originally belt driven and that this feature was changed to a motor drive. The pillar that supported the pulley stand was too high to serve conveniently as a motor support, so it was discarded and a shelf substituted, as shown in the sketch. The same pulley stand and crank shaft was utilized, but the pulleys were removed and a gear was applied in their place. The lowering of the crank shaft necessitated the shortening of the connecting rods to 30 in. The pumps were worn to such an extent that they had to be rebored and new plungers made. The original plungers, of which there are two, were $\frac{3}{4}$ in. and 1 in. in diameter, respectively, but the new ones were made 1 in. and $1\frac{1}{4}$ in. diameter. The change in the plunger diameter provided sufficient pressure for driving box work.



Sketch Showing the Original Press and the Amount It Was Reduced in Order to Handle Driving Boxes

A 5-hp., 3-phase, squirrel cage induction motor, controlled by a 3-ampere, 440-volt General Electric starting switch, furnishes power for the machine. The gearing consists of a rawhide pinion, $3\frac{4}{5}$ in. pitch diameter, $2\frac{1}{4}$ in. face with 19 teeth, and a large gear with $20\frac{2}{5}$ in. pitch diameter, 2 in. face, with 102 teeth. The motor, when loaded, runs at 1,160 r.p.m. The speed of the crank shaft is 216 r.p.m. This may appear to be fast for a pump to run, but from the experience in this shop, it has proved to be quite satisfactory. The ram is $8\frac{1}{2}$ in. in diameter. Considering the gearing ratios and the area of the pump plungers to the ram, it is calculated that the ram will travel 22 in. per minute. Accordingly, the power developed by the ram when pressing in brasses at 35 tons will be 130,000 ft. lb., or approximately four horsepower.

According to these figures, the reader will doubtless consider a 5-hp. motor as too small on account of the fact that the overall efficiency would have to be 80 per cent, which is impossible. The efficiency of the motor alone is not much more than 80 per cent. But when it is considered that the load is of only short duration, and the motor a 40-deg. motor, it can stand to be overloaded for short periods as much as 200 per cent. In this case, then, the overall efficiency can be as low as 40 per cent.

Some of the details are shown in the sketch that have been added to facilitate the handling of driving box brasses. Shoe *A* is made to fit the ram and is reduced in diameter toward the driving box end in order to accommodate the smallest driving box. Several sizes of the tip *B* are made to go over the small end of the shoe *A* so as to fit the different sizes of driving box brasses. A post crane is provided from which a $\frac{1}{2}$-ton differential chain block is suspended for handling the boxes and rods. The hooks *C* are used for grabbing the box as shown in the sketch at *D*.

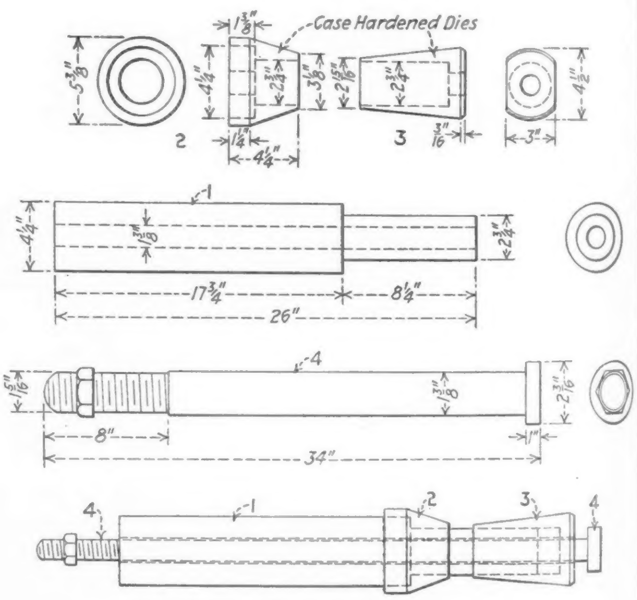
The work of shortening the press was performed with an acetylene torch. The total cost of reconditioning, including the electric drive, was $284.90.

An Adjustable Crosshead Mandrel

By H. H. Henson
Southern Railway, Chattanooga, Tenn.

A MANDREL used to set up crossheads on a planer is shown in the drawing. This tool should be permanently fixed in V-blocks on the back end of a planer so that it is always ready to take care of any emergency work that may be necessary for the enginehouse.

The device consists of four parts, namely, the mandrel, two cones, and the tightening-up bolt. The mandrel and two cones are made from a good quality of steel and case-hardened. The cones are tapered to fit into the taper in the crosshead, enabling the operator to quickly draw it up to working position. As piston tapers vary considerably, it is advisable to have two or three sizes of these cones on hand to take care of any crosshead that may have to be finished.



A Mandrel for Quickly Setting Up Crossheads on a Planer

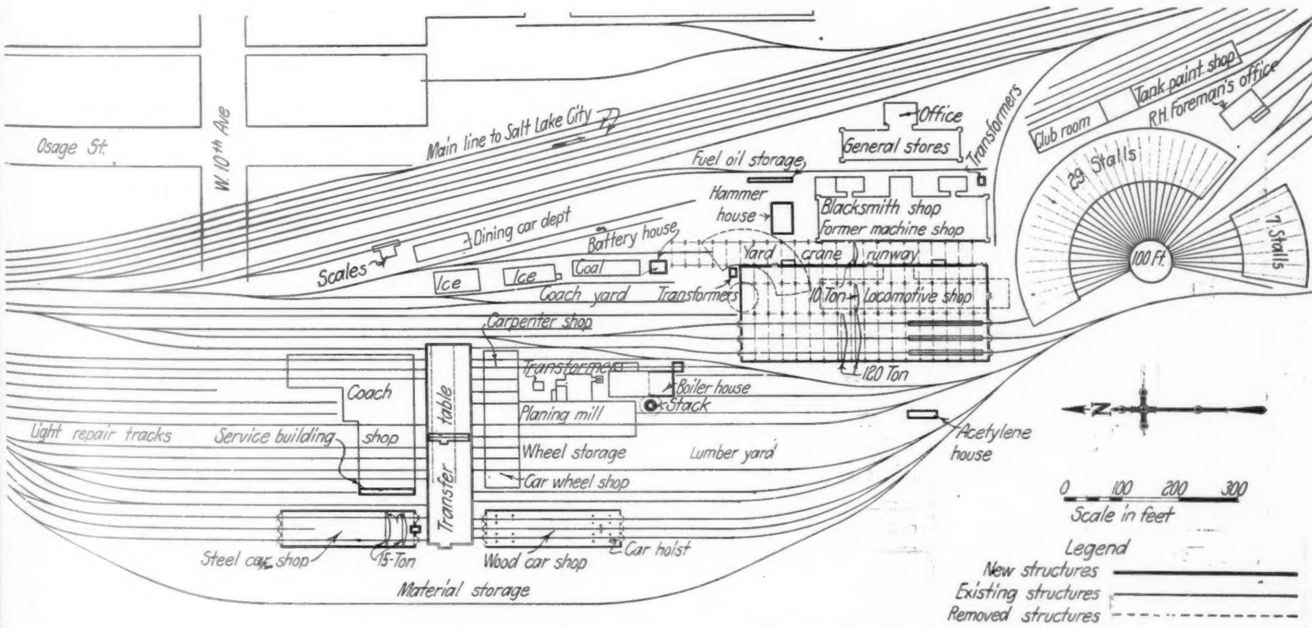
It is very easy to set up the crosshead for planing. Referring to the drawing, first detach rod *4* and cone *3*. Place the crosshead on cone *2* and then put rod *4* through mandrel *1* and tighten the nut on the rod. This squares up the crosshead and insures an accurate job. By the use of this mandrel, the average time to plane a crosshead complete is about 30 min.

The Heavy Machine Bay in the Denver Locomotive Shop, Showing the Wheel Department

Locomotive Shops Reconstructed on D. & R. G. W.

Program Includes Additions to the General Repair Plants at Denver and Salt Lake City

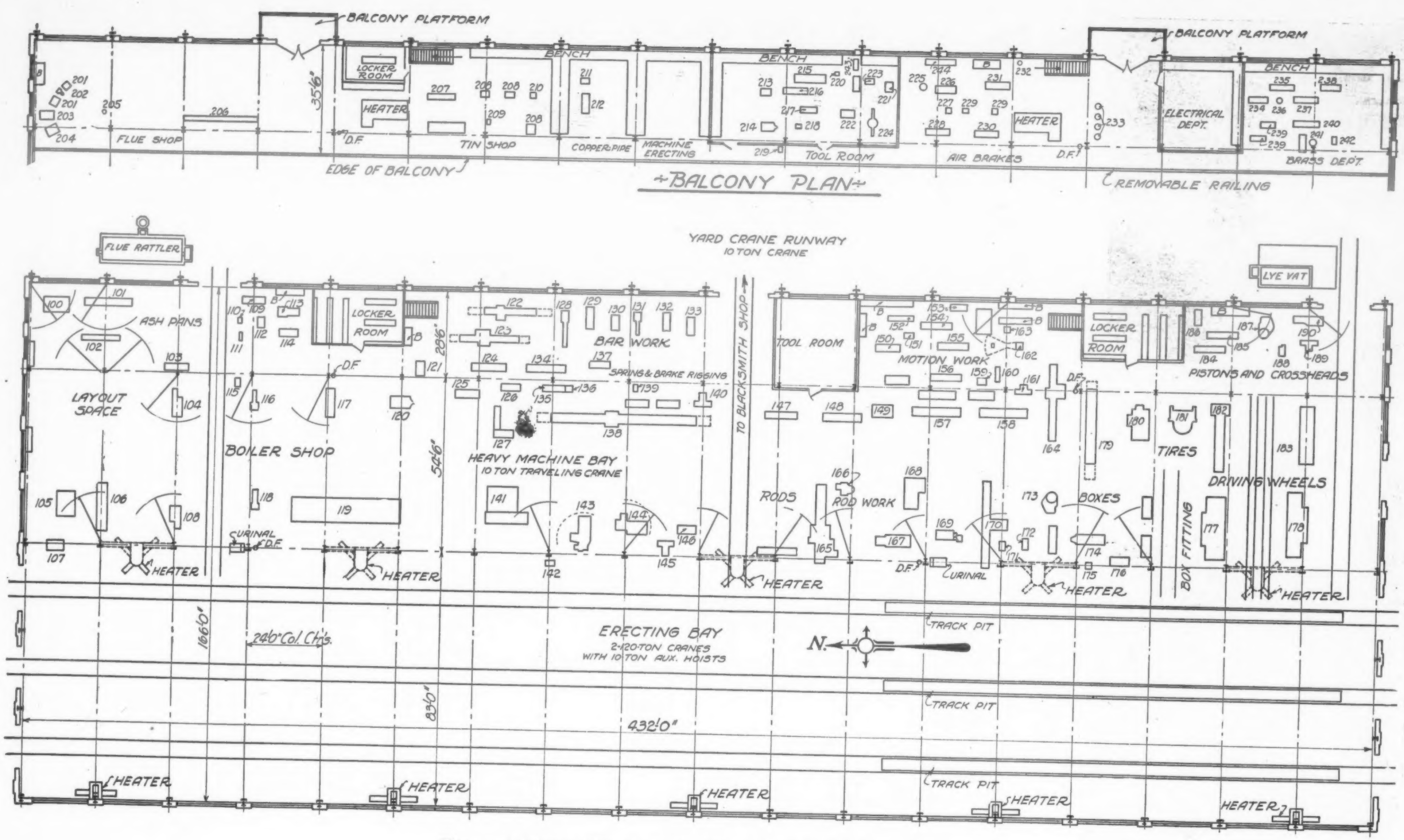
THE construction program undertaken by the Denver & Rio Grande Western late in 1923, which involved an expenditure of nearly $3,000,000, is now nearing completion. This program was the result of a survey which was made in order to solve the problem of maintaining a proper balance between the constantly increasing size and number of locomotives and cars, and the facilities for main-



The Layout of the Denver Shop Track and Buildings

taining and handling this equipment. In this survey consideration was given to all of the elements affecting the maintenance of equipment and the care of locomotives at terminals to determine the necessity for additions to existing facilities, with the purpose of counteracting the increased cost of maintenance due to high wages, more intricately designed locomotives and heavier units in both locomotives and cars, as well as to decrease the delayed time used in holding equipment under repairs. This investigation included many important items, such as the distribution of equipment, the source of supply of materials, the labor market, the continuation of existing facilities, and the probable future traffic developments.

Increased labor rates and correspondingly increased costs of freight car maintenance, which has brought the total sum now being expended for the repair of freight cars up to and sometimes in excess of the cost of maintenance of locomotives, have made it of vital importance that facilities be provided to assist in reducing this cost. Particular attention has been given to this subject on the Denver & Rio Grande Western with the result that identical freight car repair shops have been built at Denver and Salt Lake City, in which production methods are being applied to repairs to freight cars with very satisfactory results. At Salida and Grand Junction old locomotive repair shops, vacated through the provision of new buildings for locomotive repairs, have been made available for housing the heavy repair



Floor and Balcony Plan of the Machine and Erecting Shop at Denver

100—Hand rolls—D. & R. G. W.
101—Flanging clamp—D. & R. G. W.
102—36 in. double end punch and shear—Williams-White.
103—Face plate—D. & R. G. W.
104—Single end punch and shear—Hilles & Jones.
105—Face plate—D. & R. G. W.
106—Flanging clamp—D. & R. G. W.
107—Flanging fire—D. & R. G. W.
108—Single end punch and shear—Hilles & Jones.
109—20 in. x 7 ft. 6 in. engine lathe—Pond.
110—12 in. sensitive drill—Rockford.
111—Hack saw—Marvel No. 2.
112—Bolt squaring machine—W. G. Young.
113—1½ in. double bolt threader—Acme.
114—1½ in. double bolt threader—Acme.
115—3 in. x 16 in. double grinder—Blount.
116—Single end punch—Cleveland.
117—48 in. rotary shear—The Quickwork Co.
118—Flange punch—Rock River.
119—Bending roll—Wicks.
120—5-ft. radial drill—Wm. H. Warren.
121—2 in. triple head bolt cutter—Landis.
122—32 in. x 32 in. x 14 ft. planer—Niles.
123—36 in. x 36 in. x 14 ft. planer—Sellers.
124—30 in. x 13 ft. engine lathe—Putnam.
125—20 in. single head slotter—Niles.
126—36 in. single head shaper—Bement Niles.

127—Cold saw—Q. M. S.
128—7½ in. x 28 in. turret lathe—Gisholt.
129—3 in. x 36 in. turret lathe—Jones & Lamson.
155—20 in. x 10 ft. engine lathe—Putnam.
156—20 in. x 10 ft. engine lathe—Putnam.
182—600-ton 84 in. wheel press—Chambersburg.
183—Quartering machine—Niles-Bement-Pond.
220—Twist drill grinder—Wilmarth and Morman.

127—Cold saw—Q. M. S.
128—7½ in. x 28 in. turret lathe—Gisholt.
129—3 in. x 36 in. turret lathe—Jones & Lamson.
130—3 in. x 36 in. turret lathe—Jones & Lamson.
131—5 in. x 24 in. turret lathe—Gisholt.
132—2 in. x 24 in. turret lathe—Jones & Lamson.
133—2 in. x 24 in. turret lathe—Jones & Lamson.
134—30 in. x 13 ft. engine lathe—Putnam.
135—Nut facer—Putnam.
136—Centering machine—Whiton.
137—16 in. single head slotter—Betts.
138—60 in. x 60 in. x 27 ft. planer—Pond.
139—1½ in. x 12 in. double grinder—D. & R. G. W.
140—24 in. upright drill—Colburn.
141—60 in. cylinder planer—Morton.
142—3 in. x 16 in. double grinder—Blount.
143—6 ft. radial grinder—American Tool.
144—6 ft. radial grinder—Niles.
145—24 in. upright grinder—Colburn.
146—50-ton vertical hydraulic press—D. & R. G. W.
147—24 in. x 12 ft. engine lathe.
148—Horizontal borer—Niles.
149—2⅜ in. x 18 in. internal grinder—Heald.
150—18 in. x 8 ft. engine lathe—New Haven.
151—16 in. x 16 in. x 46 in. planer—Miles.
152—24 in. x 9 ft. engine lathe.
153—16 in. x 6 ft. engine lathe—Putnam.
154—20 in. x 10 ft. engine lathe—Putnam.
155—20 in. x 10 ft. engine lathe—Putnam.
156—20 in. x 10 ft. engine lathe—Putnam.
157—42 in. x 16 ft. 6 in. engine lathe—Putnam.
158—36 in. x 14 ft. engine lathe—Wm. Bement & Son.
159—2 in. x 16 in. double grinder—D. & R. G. W.
160—12 in. x 50 in. grind stone—D. & R. G. W.
161—24 in. upright drill—Colburn.
162—Link grinder—Hemmet No. 2.
163—Screw press—D. & R. G. W.
164—42 in. x 42 in. x 16 ft. planer—Sellers.
165—48 in. x 42 in. x 14 ft. slab miller—Bement.
166—44 in. boring mill—Niles, Bement, Pond.
167—60 in. horizontal borer—Niles.
168—Adj. rotary miller—Ingersoll.
169—50 in. x 14 in. x 21 in. universal miller.
170—Guide bar grinder—Diamond.
171—3 in. x 16 in. double grinder—J. C. Blount.
172—4 in. pipe cutter—Oster.
173—42 in. vert. turret lathe—Bullard.
174—4-ft. radial drill—Dreses.
175—Pneumatic pipe bender—Underwood.
176—50-ton vert. hyd. press—D. & R. G. W.
177—79 in. driving wheel lathe—Niles.
178—90 in. driving wheel lathe—Putnam.
179—48 in. x 48 in. x 16 ft. planer—Putnam.
180—H. D. draw cut shaper—Morton.
181—84 in. vertical borer—Niles.
182—600-ton 84 in. wheel press—Chambersburg.
183—Quartering machine—Niles, Bement, Pond.
184—17 in. x 10 ft. engine lathe.
185—17 in. x 10 ft. engine lathe.
186—Keyway machine—Bement, Miles.
187—42 in. vert. turret lathe—Bullard.
188—4 in. x 36 in. single grinder—D. & R. G. W.
189—24 in. upright drill—Colburn.
190—42 in. turret lathe—Grant.
201—Two-flue fires—D. & R. G. W.
202—Flue horn—D. & R. G. W.
203—Flue welder—Hartz.
204—Flue swedger—D. & R. G. W.
205—Pivot—D. & R. G. W.
206—Flue cutter—D. & R. G. W.
207—Cornice brake—Peck, Stowe & Wilcox.
208—Three-squaring shears—Peck, Stowe & Wilcox.
209—Single end hand punch—D. & R. G. W.
210—Splitting shear—Badger.
211—2½ in. x 8 in. pipe cutter—Saunders.
212—⅛ in. x 2 in. pipe cutter—Saunders.
213—Universal miller.
214—Die singer—Pratt & Whitney.
215—18 in. x 10 ft. engine lathe—Lodge & Shipley.
216—20 in. x 10 ft. engine lathe.
217—16 in. x 6 ft. engine lathe—Putnam.
218—12 in. sensitive drill—Conover & Overcamp.
219—Hack saw—Thompson.
220—Twist drill grinder—Wilmarth and Morman.
221—Universal grinder—Landis Tool Co.
222—12 in. shaper—Bement.
223—Water tool grinder—Gisholt.
224—Surface grinder—Thompson.
225—Sensitive drill—D. & R. G. W.
226—18 in. shaper—Bement Miles.
227—Grinder—D. & R. G. W.
228—16 in. x 8 ft. engine lathe—Fitchburg.
229—Two 2 in. x 16 in. double grinders—D. & R. G. W.
230—16 in. x 8 ft. engine lathe—Fitchburg.
231—20 in. x 8 ft. engine lathe—Reed.
232—Air compressor—Westinghouse.
233—Pump racks—D. & R. G. W.
234—18 in. x 6 ft. brass lathe—American.
235—20 in. x 10 ft. engine lathe.
236—Valve grinder—Automatic.
237—18 in. x 6 ft. brass lathe—American.
238—20 in. x 8 ft. engine lathe—Putnam.
239—Two 14 in. x 5 ft. 6 in. brass lathe—American.
240—16 in. x 6 ft. brass lathe—Acme.
241—Air reservoir—D. & R. G. W.
242—1½ in. x 12 in. double grinder—D. & R. G. W.
243—Dumb waiter—Kimball.
244—Triple valve test rack—Westinghouse.

freight cars originating at these intermediate terminals, not scheduled for repairs at the main repair plants.

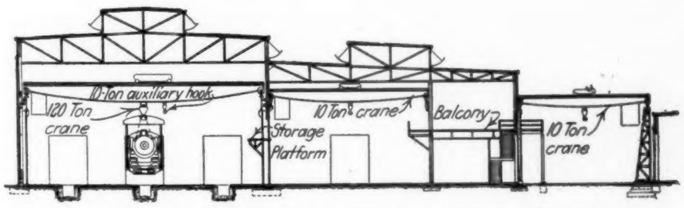
The New Locomotive Shop at Denver

The Denver, Col., terminal is located at Burnham, just inside the southern limits of the city. The new development consists essentially in the provision of a large, modern locomotive erecting and machine shop; a steel car shop and a wood car shop. An extension of the existing boiler plant and the addition of oil storage, electrical and service facilities, was also necessary to serve the new repair plant. The former machine shop has been converted into a blacksmith shop and a yard crane runway with a 10-ton crane is provided between this and the locomotive shop to serve both.

The locomotive shop is a brick and steel frame building 432 ft. long by 165 ft. wide. It is divided longitudinally into two bays of nearly equal size, one of which is designed for an erecting and boiler shop bay, while the other is given over to machine tools.

The erection bay is traversed by three through tracks, each of which runs over an engine pit at the incoming end. Two 120-ton Whiting overhead traveling cranes span the bay on a runway the full length of the building. These cranes can lift a locomotive at any point in the erecting bay and place it at any other point, permitting full use of the erection space.

The far end of the erecting bay is used as a boiler shop, so that the latter is served by the cranes which also serve



Section Through the Locomotive Shop at Denver

the unwheeling and erecting space. A narrow platform or balcony extends the length of the bay on the side toward the shop for the storage of locomotive parts. This balcony is also served by the large cranes, each of which is provided with a light auxiliary hoist on the shop side of the main hoist for handling parts.

The transportation of parts about the shop is handled by interlocking crane and truck systems. The machine tool bay is served by a 10-ton overhead traveling crane. This crane serves directly all of the machine tool bay that is not under the balcony, as well as the inner seven feet of the balcony, and is used both for transferring parts between the two levels and for longitudinal transportation on either level.

Both storage battery electric trucks and gasoline tractors with trailers are used for transporting parts between the bays and to locations inaccessible to the cranes. These trucks are also used to bring raw materials into the shop and to carry finished parts outside for stock storage or for shipment to other points. Easy operation of the trucks is assured by the installation of creosoted block floors on a reinforced concrete base.

A 50-ft. yard crane runway and storage bay, extending the length of the shop and several bays beyond on the machine tool side, facilitates the handling of materials and parts into and out of the shop, beside providing liberal handy storage space. The crane, spanning the full bay, can load or unload trucks at any point. A track extends three car lengths under one end of the craneway to allow for the easy unloading of materials from outside and the loading of parts for other points. Two extensions of the shop balcony into the craneway permit the handling of materials back and

forth between the craneway and the shop balcony direct. All transportation, both external and internal, is thus tied together into a compact, interlocking, free moving system.

The efficiency of the workmen is facilitated by providing the best possible lighting, both natural and artificial, well distributed throughout the shop. Large wall sash of Truscon design are provided on all sides and in addition an overhead monitor extends practically the full length of the building over the center of each bay. Heating is provided by a system of unit hot blast heaters distributed along the wall and bay lines through the shop. Complete service facilities, including lockers, are located on both the main floor and the balcony at points as nearly central as possible to the men served by each of them.

The blacksmith shop is reconstructed from the old machine shop and also lies adjacent to the crane runway opposite the locomotive shop. This shop is also tied in with the general transportation system already outlined. In addition, a standard gage track extends from the erection bay of the locomotive shop into the blacksmith shop for the transportation of heavy forgings back and forth.

This shop is given over to forging and heat treating, with a well organized spring manufacturing and assembly department, an acetylene cutting and welding department and a brass foundry. Like the locomotive shop, the blacksmith shop is also highly departmentalized and considerable thought has been given to reducing manpower and lost motion to a minimum.

The Machine Tool Layout

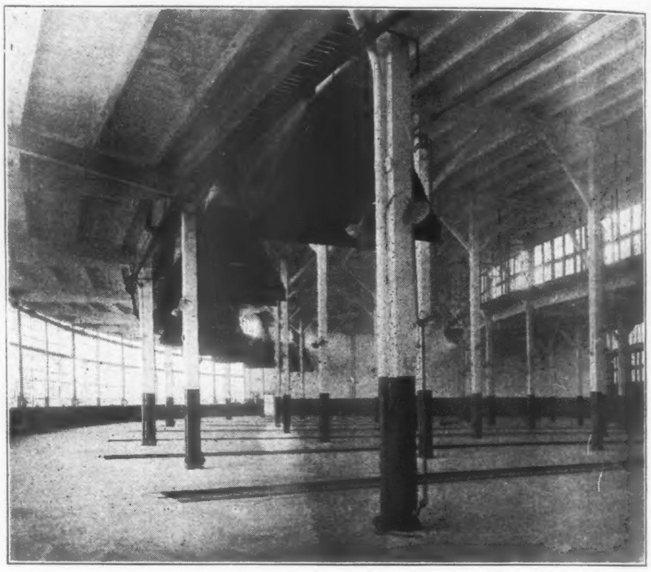
In the layout of departments and machine tools particular attention was given to the relation between the various subdepartments and tools were grouped with the idea of making each department complete in itself as far as possible, locating tools serving more than one department so that such service could be made with the least movement of material.

The driving wheel department is located opposite the in the bay served by the 10-ton crane and in addition to the service of the traveling crane, jib cranes and hoists for individual machines have been liberally supplied.

The driving wheel department is located apposite the stripping track so that drivers are immediately delivered to the wheel department for tire renewals or for wheel turning, quartering, journal and pin turning or axle renewals. As soon as they are completed they are stored in the aisle between the wheel machines until they are to be assembled for box fitting. Machinery for box repairs is adjacent to the box fitting floor, conserving space and reducing movement on all box work to a minimum.

The rod work, located next to the box department, is served by the traveling crane and jib cranes, and is also located close to the assembly floor. Floor space in the storage of rods is conserved by means of "A" frame racks, so designed that all rods can be easily stored and delivered without interference. This department is also located close to the thoroughfare to the blacksmith shop, making movements to that shop simple as possible.

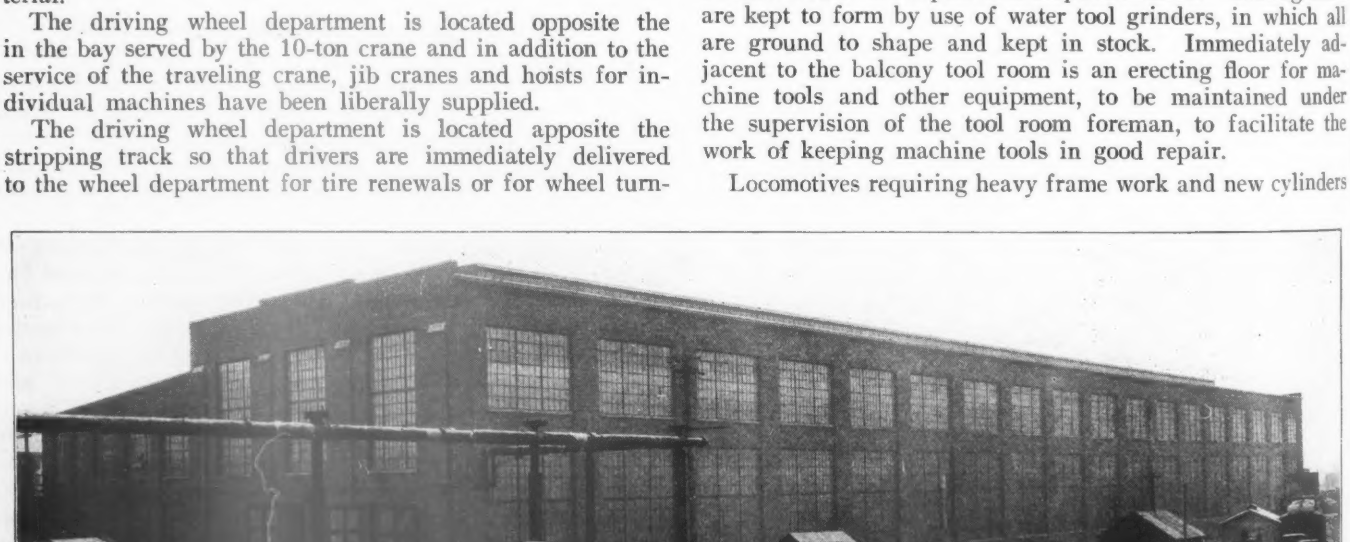
The tool room is composed of a tool storage space on the ground floor, with a repair and manufacturing department on the balcony. Communication is furnished by means of a small elevator, by which cutting tools, air tools, etc., may be delivered to the repair and inspection floor. Cutting tools are kept to form by use of water tool grinders, in which all are ground to shape and kept in stock. Immediately adjacent to the balcony tool room is an erecting floor for machine tools and other equipment, to be maintained under the supervision of the tool room foreman, to facilitate the work of keeping machine tools in good repair.



Interior of the Salt Lake City Engine House, Showing the Natural Illumination

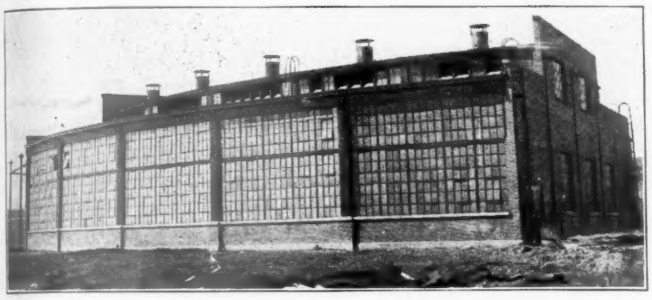
Locomotives requiring heavy frame work and new cylinders are located in the erecting bay opposite the group of tools assigned to the work of machining these parts. These tools are also located adjacent to the thoroughfare to the yard crane and blacksmith shop to provide short movement to the yard crane and to the smith shop.

The balcony on which are located the various departments requiring lighter machinery is provided with a continuous landing platform under the heavy machine bay crane, on



Exterior of the Denver Locomotive Shop

which all parts may be landed at any point, and has in addition two landing platforms under the yard crane runway. Advantage is taken of this latter point in locating the flue welding department in the balcony in the boiler shop end of the building. Flues are handled from locomotives in a movement across the shop to the rattler under the yard crane, being deposited in a barrel rattler designed to load and unload its entire capacity each with one move. Flues are lifted from the rattler by the yard crane directly to the landing platform, where they are placed upon specially designed flue trucks, holding just the capacity of the rattler. In this way the flues are not handled singly except as they are safe-ended or cut to length. From the welding department they can be returned



The Alamosa Engine House Shows Typical Construction in Which Large Areas of Glass Are Used

to the yard crane runway for storage, or delivered from the balcony direct to the boiler shop floor by the messenger crane.

Pipe benches and tools for locomotive pipe work are located near the erecting pits, so that pipes may be repaired and erected with little lost movement.

In the purchase of new machine tools for this shop special care was given in the selection of tools, taking into consideration the use, character and quality of the tools best adapted to the work, with due consideration as to outlay. Particular attention was given to the development of grinding and milling operations in place of planing, as far as these operations could be practically applied to locomotive repair work.

The routing of locomotives through the shop from the stripping pit back to the assembling pits is worked out with the least loss of movements of the various parts taken as a whole. With the planning system of scheduling repairs to all parts it is expected that the days in the shop for each locomotive will be very greatly reduced, and therefore fewer locomotives will be under repair at one time than has been necessary with the old facilities.

Other Facilities

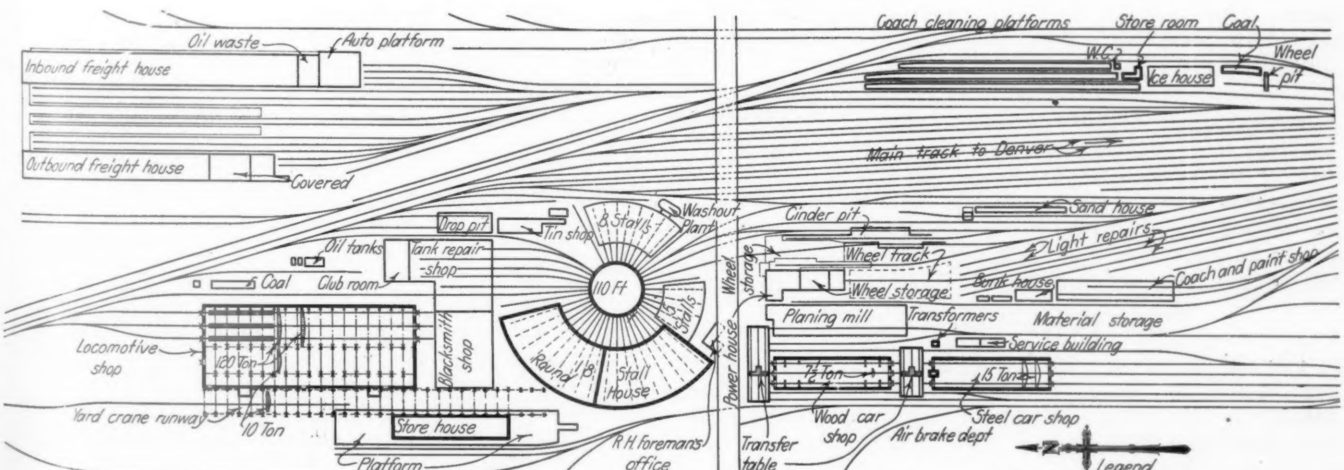
To provide the necessary increase in boiler capacity, a 45-ft. by 46-ft. extension has been built on the south side of the old boiler house, and 600 hp. additional boiler capacity installed, bringing the total capacity to 1,600 hp. at normal rating. Stokers, feed water regulators, pumps and other modern equipment have also been installed, and a 225-ft. radial brick stack, new breeching and adequate ash handling facilities make the whole into a modern efficient plant.

The power requirements of the shop and terminals are supplied from outside. The increased power demand called for increased transformer and distribution capacity. To provide this, two new transformer houses have been added, so located as to minimize the length of the distribution lines.

Acetylene cutting and welding equipment is installed in the enginehouse, locomotive and blacksmith shops. This equipment is supplied through overhead pipes from an acetylene house on the west side of the yard, well away from other buildings.

The existing engine terminal had a 7-stall and a 29-stall enginehouse, served by a 100-ft. turntable. Twelve stalls of the latter house were used as a locomotive shop and were not available for regular enginehouse service. By throwing all shop work into the new locomotive shop, these stalls are released for regular enginehouse service. A 50 per cent increase in effective enginehouse capacity is thus attained without building any additional stall space. This is amply sufficient to take care of the requirements of the present and the immediate future.

In laying out this plant, consideration has been given not only to present requirements, but also to requirements several years in the future as well. The shops are all so located as to be susceptible of substantial extension without any change whatever in the general scheme, and with a minimum of interference to operations. The extension of the boiler house is large enough to permit the installation of 600 hp. additional boiler capacity. The same provision for future as well as present extensions has been carried out in the construction of sewer, water and other service facilities.



The Shop Layout at Salt Lake City

The Salt Lake Installation

The new development at Salt Lake follows the general plan of the layout at Denver. At Salt Lake, however, the

heavier grades and the greater curvature in the tributary territory call for heavier boiler, tire, driving box and other heavy machinery repair work, so that more space has had to be given to these departments. An increase in storehouse space was also found necessary and the increasing number of 2-8-8-2 heavy Mallet locomotives called for an enginehouse of longer stall construction than that of the existing enginehouses to permit their rapid and economical handling. The arrangement of the existing yard also made the new Salt Lake development somewhat more difficult than that at Denver, and required the departments to be grouped in a different manner.

A locomotive shop, a steel and a wood car shop and a yard crane runway have been built of substantially the same design as those at Denver, together with a two-story storehouse, 50 ft. by 242 ft., and an 18-stall enginehouse, 126 ft. deep. As to Denver, the existing machine shop has been converted into a blacksmith shop, while an existing erection shop has been converted into a tank shop and a number of consequent additions and alterations have been made to other departments.

Locomotive Shop Resembles That at Denver

The locomotive shop is of the same design and track layout as that at Denver. The tool department layout also copies that at Denver, though some of the individual tools are somewhat different, on account of the different class of locomotives to be handled. This shop is also served by two 120-ton Whiting cranes with 10-ton auxiliary hoists in the erecting bay and by a 10-ton crane in the machine tool bay. Electric and gasoline trucks also serve to transfer parts between the two bays and between the shop and the yard crane runway.

A yard crane runway with a 15-ton crane extends the full length of the shop along the machine shop side of the building and serves as a receiving and storage space for parts and materials. Beside the tracks already referred to two standard gage tracks extend through the shop and into the runway at right angles. These serve for the transportation of heavy parts. One of the yard tracks extends about 300 ft. from the north underneath this crane runway, for loading and unloading cars from outside.

The runway extends several bays beyond the end of the locomotive shop and also serves the blacksmith shop. This building was formerly the machine shop and lies on the same side of the runway, about 40 ft. clear to the south of the locomotive shop. This shop is equipped and departmentalized like that at Denver, although the different shape of the building calls for a slightly different arrangement of the groups, and no brass foundry is required at Salt Lake.

Storehouse Was Rebuilt

The old storehouse, which was located on the side of the new locomotive shop, was no longer adequate for present needs. It was consequently torn down and a larger two-story storehouse, 50 ft. by 242 ft. was built in its place. This is a brick and timber mill construction building. Following the plan of grouping buildings as far as possible around the crane runway, it is located alongside the latter opposite the locomotive and blacksmith shops.

The storehouse is entirely surrounded by a concrete paved platform at car-floor level. This platform is 10 ft. wide along both sides of the building and is about 450 ft. long, providing liberal outdoor storage space at both ends of the building. The entire length of the east 10-ft. of this platform is under the crane runway and is also served by the yard track under the runway, which is located next to the platform. The west side of the platform is served by another yard track throughout its length, giving ample unloading space.

The first floor of the storehouse is given over to storage space and the storekeeper's office. Only half of the second story, however, is storage space, the balance being given over to executive offices of the terminal. A centrally located elevator and stairway provide for vertical transportation.

The old engine terminal had an enginehouse of 5 stalls, one of 8 stalls and one of 16 stalls, all served by an 80-ft. turntable. While the number of stalls available was substantially sufficient for present needs, the length of stall in none of them was sufficient for adequate, economical service to the longer locomotives, of which increasing numbers are being assigned to the lines tributary to Salt Lake. Consequently, the old 16-stall house was torn down and its place taken by a new 18-stall house, 126 ft. deep on the same site, the old 80-ft. turntable being replaced by a new 110-ft. continuous turntable of American Bridge Company design and manufacture.

Enginehouse Includes Novel Features

As past experience with timber and concrete frame enginehouses has not shown advantages in concrete commensurate with its much greater first cost as compared with timber and as a well-built timber enginehouse of fire-resisting mill construction rarely burns, this new enginehouse is built of brick and fire-resisting mill construction and is divided into two equal parts by a fire wall. It is provided with a clerestory about 70 ft. wide, placed well toward the rear of the house, fully glazed on both sides and with operating sash to give good ventilation.

The economical and rapid handling of heavy modern engines with their greater weight of parts demands some kind of mechanical equipment for the dismantling, transportation and reassembling of these parts. Jib cranes and overhead cranes have been used for this to some extent, but their high cost, comparative slowness and lack of flexibility threw the balance in favor of the use of crane trucks for this purpose. These trucks, capable of picking up parts quickly at any point and transporting them to any other point inside or outside the house without transfer and independently of tracks, are rapid, flexible and economical.

To insure the satisfactory, permanent operation of these trucks, a paving brick floor on a reinforced concrete base was laid throughout the building. The use of reinforcement in an enginehouse floor is rather unusual, but a scheme was worked out whereby the reinforced floor slab, acting as a beam extending from pit to pit, and tied in with the reinforcing in the pits, stiffened the pits and took part of the jacking loads from them so that a much lighter cross-section of pit could be used than would otherwise be required. This reinforced floor slab also permitted the elimination of the concrete piers under the interior building posts, the latter being carried directly on the slab. Thus the whole floor and pit system, though much stronger, was no more expensive than the massive pits, unreinforced floor and building piers that would otherwise have been used.

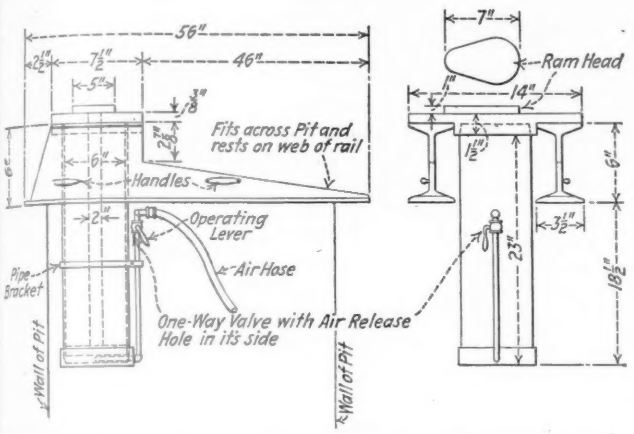
The building is heated by direct radiation, coils being distributed under ledges at both sides of the pits and around the rear wall.

Shoe and Wedge Pit Jack

SHOE and wedge men find the device shown in the illustration very convenient in fitting shoes and wedges and with it pedestal binders are easily raised into position. With this jack two men can quickly apply the shoes, wedges and binders on the largest locomotives. It is useful both in the enginehouse and back shop.

The jack consists of a six-inch air cylinder in which a five-inch ram head works on a two-inch piston rod. The air is admitted to the bottom of the cylinder by a one-way air valve. The valve contains an air hole through which the air is released when lowering the jack. At the top of

the jack there is a 7½-inch collar under which fits a bracket or casting which spans across the pit and rests on the web of the rail. This bracket contains two handles by which



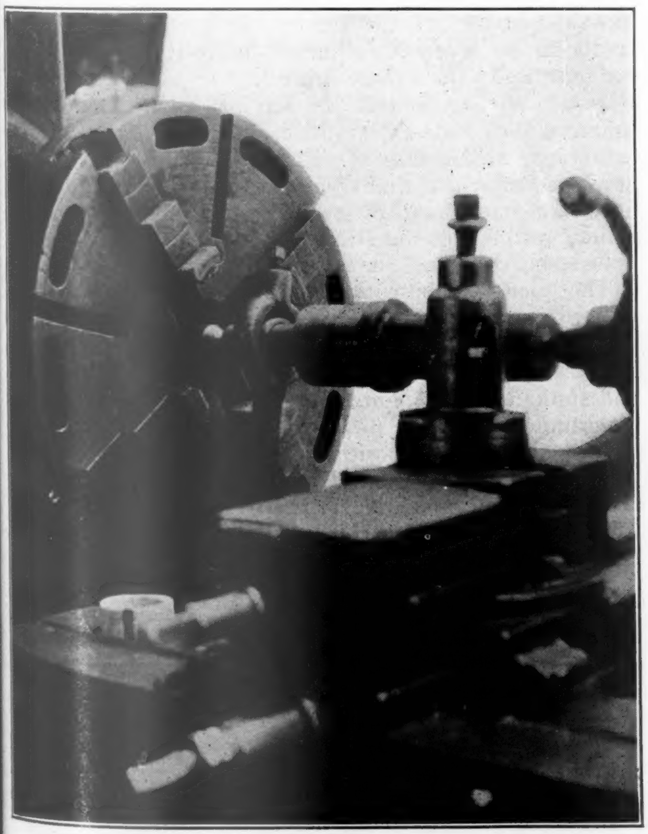
Pit Jack for Rapidly Placing Shoes, Wedges and Pedestal Binders in Position

the jack may be moved. After one pedestal binder is put up in position it is an easy matter to slide the jack along the top of the rail to the next binder.

Holding Lathe Work Without Injury

By Lloyd R. Carson

In turning such work in a lathe as a brake hanger pin, valve stem or other work necessitating the reversal of the part end for end in the lathe the mechanic often finds it necessary to use a lathe dog in order to allow the work to run on the centers and still run true. In many cases the set screw of the lathe dog makes a flat spot on the work, and, on any part such as a valve stem which requires a steam



The Split Sleeves Protect the Finished Surfaces

fit or polished surface, this is injurious. Moreover should the work in any way catch or cease to rotate, the set screw will gouge it. This is true not only of the set screw in a lathe dog but also of the jaws of a chuck.

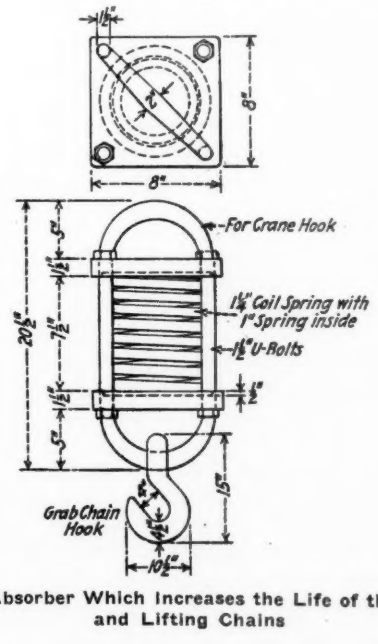
The following method has proved to be a remedy for these drawbacks of the lathe dog and allows the mechanic to place the work in a chuck, should he wish to true his work up in that manner.

Take an old bushing which has been discarded, or the ends of bushings which have been removed in cutting off new bushings after they have been turned and bored. Place in a vise and with a hack-saw remove ¼ in. or ⅜ in. from the entire length of one side. File the edges so as not to leave a rough edge on the inside of the bushing. This makes a split sleeve which can be slipped over the work, and the lathe dog or chuck jaws tightened down on it. The mechanic will find that when the lathe dog or chuck is tightened this collar will bear at all points on the work, thus allowing a heavier cut without fear of injuring the work.

In a surprisingly short time pieces can be found to suit the requirements of any size work. It is not necessary to have the sleeves the exact size of the work because the metal removed in cutting the sleeve provides for some closing in to suit the work. These collars can be used many times on different size work as they spring back to their former shape when removed. They will also be a great help in holding work in a vice or shaper where it must be held firmly without injury.

Crane Shock Absorber

There is in use at the Lehigh Valley Shops at Sayre, Pa., a crane shock absorber for which it is claimed that since it has been applied there has never been found a broken chain or a cable. It is hung on the crane hook and the grab chain hook is attached to the pick-up chain. This arrangement places it between the crane and the work which



Crane Shock Absorber Which Increases the Life of the Crane Cable and Lifting Chains

is to be lifted. It receives all sudden shocks and strains caused by the jerking and twisting of the object as it is being raised. The elimination of these shocks prolongs the life of the crane cable, chain and crane.

The device is very simple in construction and can be readily made in the blacksmith shop. The most important parts are the two helical coil springs. These springs are tested to withstand a load equal to twice the capacity of the crane.

Proceedings of the Boiler Makers' Convention

The Discussion Developed the Advantage of the Interchange of Ideas on Boiler Construction

THE proceedings of the opening session of the fifteenth annual Convention of the Master Boiler Makers' Association, which was held at the Hotel Sherman, Chicago, May 20 to 23, were published in the July issue of the *Railway Mechanical Engineer*, and abstracts of the papers on the application of Thermic Syphons and Autogenous Welding and Its Uses were published in that issue. Other papers presented during the convention are abstracted below.

Training Apprentices

Railroads—Employees—Training

The great need of this country today is a revival of respect for genuine old time skilled craftsmanship. There is a growing conviction among thoughtful men that a grave mistake has been made in making apprentice restrictions too drastic. It requires youth and vitality to make anything a success these days, and the skilled trades are no exception to the rule.

It is recognized that the best results in apprenticeship can only be accomplished by educational facilities on the shop property during working hours with the apprentice under pay, combined with shop instruction, conforming to a regular schedule of advancement.

Never was there so great a need for skilled mechanics as there is today, but we cannot develop real mechanics unless a definite and adequate plan of training is adopted and rigidly adhered to. A thorough course of training for each trade must be laid out and some one must be responsible for seeing that each boy is carefully conducted through the course. There must be a definite amount of school instruction in order that the boy may be given a thorough understanding of the underlying principles of the job. Means must be provided to insure thorough training of the apprentice in the shop work, by the use of shop instructors who devote their entire time to the instruction of the apprentices, directly on the work in which they are engaged in the shop. It has been demonstrated that the use of a shop instructor as indicated, results in a material increase in output, and is therefore immediately profitable to the railroad company, as well as ultimately beneficial in providing a group of well trained and well intentioned graduates to fill the places made vacant by promotion or other causes.

It has been found that the best results in apprenticeship training are accomplished by a plan embodying instruction in the standard practices of the railroad company and all lesson papers and shop instructions should be arranged with that object in view in order to thoroughly drill the apprentice in the company standard practices, at the same time he is being taught drawing, mathematics, and shop methods.

A number of railroad companies have a very complete apprenticeship system extending over the entire railroad and in successful operation for a number of years. Usually there are three groups of apprentices, as follows:

Classes of Apprentices

Regular apprentices should be boys 16 to 21 years of age, having a high school education or equivalent, and in good health. Schools be maintained at the shops, four to six mornings per week. Attendance be compulsory and under pay, but the minimum requirements not severe. Each apprentice be given instructions in mechanical drawing, shop mathematics, physics and related subjects during two periods of two hours each per week. It will be realized that many boys who have not had much early education, still have good intentions and respond to a genuine opportunity to improve their condition by attending the schools. The course in each of the mechanical trades is for four years in school and shop. The shop to have an instructor to supervise the movements of the apprentices in the shops, give them instructions in the proper methods to follow and arrange for them to be moved in accordance with the schedule established for each trade. The shop instructors should not assign work, but instruct the apprentices in the work which the department foreman has assigned to them.

The lesson papers, drawings, problem sheet, T-squares, angles, pencils, paper, and everything except the set of drawing instruments should be furnished by the company. The instruments can be purchased by the instructor for the apprentice at a reduced rate made with the manufacturers.

Helper apprentices should be young men 21 to 30 years of age, in good health, who have had two or more years' continuous experience as helpers in the shop from which application is made, should be given one year allowed time and serve a three-year apprenticeship course. Attendance at the school could be optional for helper apprentices. The shop instructors also should look after the progress of the helper apprentice.

Special apprentices should be young men 18 to 26 years of age, who are graduates of a mechanical engineering course in college and have good health. They can be placed on the regular work in the shops and assigned to special work on tests and selected duties as required. These men need not attend the shop schools.

Many men now occupying good positions in railroad service are graduate apprentices of different railroads, it may be said that the railroad service offers as good opportunity for the future as any other line of work. It should be pointed out that ability to acquire knowledge is not alone sufficient to insure advancement in the service; some other desirable characteristics such as executive ability, initiative and common sense are necessary, and are sometimes unexpectedly developed after a period of experience. Many of these men have been advanced to good positions. This plan, we believe, will help materially to increase the bond of mutual interest between the company and the employees.

The plan of apprenticeship should include the boilermaker's trade with others, in the manner described. This trade should be more attractive to young men than heretofore on account of the introduction of labor saving tools and appliances and improved methods. There is an excellent opportunity for young men who are thoroughly qualified to advance beyond the position of workman.

This report was signed by the following committee: George B. Usherwood, N. Y. C. (chairman), W. J. Murphy (Penn. System), John Harthill (N. Y. C.) and John F. Raps (I. C.).

A Paper on Welding

By A. G. Pack

Chief of Bureau of Locomotive Inspection

I recognize that autogenous or fusion welding is among the most valuable modern discoveries when used with good judgment and discretion, however, it has not yet advanced to a stage where it can be considered "a cure-all."

I do not believe that it should be used on any part of the

locomotive boiler where the strain to which the structure is subjected is not fully carried by other construction, which meets with the requirements of the Locomotive Inspection Law and Rules which are based on recognized standard practices of the best authorities, nor on any other part of the locomotive which is subjected to severe strains and shocks where through failure, accident and injury might result. This will be my position until its reliability has been established beyond a reasonable doubt, or until some means is discovered whereby the value of the weld can be established before failure occurs.

It is too well recognized that the value of welding varies with the different welding operators, and even with the same operator, to give it a definite value.

It is further established that autogenous welding changes the structure of the material to which it is applied to such an extent that the material cannot be depended upon as retaining its original physical properties. The welding of seams or cracks in the boiler backhead, where men are constantly employed in close proximity, should never be permitted except where the welding is covered with a patch secured by patch bolts, studs, or rivets. Some of the most serious accidents have been investigated by the Bureau of Locomotive Inspection where welded seams in boiler backheads failed, which has led me to this final conclusion.

Our records, as kept by years, show for the period July 1, 1915, to April 30, 1924, the relative effect of crown sheet failures in which the sheets pocketed or bagged as compared with those in which the sheets tore. The term "involved," as used in our study, refers to seams that were included in the pocketed, bagged or ruptured area.

During the period July 1, 1915, to April 30, 1924, inclusive, there were 495 accidents due to firebox crown sheet failures which resulted in the death of 326 persons and the serious injury of 761 others, or an average of 0.66 killed and 1.54 seriously injured per accident.

In 286 of the 495 failures the sheets bagged or pocketed, but did not tear, as a result of which 48 persons were killed and 474 others were seriously injured, or an average of 0.17 killed and 1.66 seriously injured per accident.

In 209 of the failures the sheets tore causing the death of 281 persons and the serious injury of 336 others, or an average of 1.35 killed and 1.61 seriously injured per accident.

It will be seen from this comparison that the fatalities where sheets tore have been eight times as great as where they did not tear. From the viewpoint of safety to persons, this very clearly illustrates the necessity for constructing firebox sheet seams in the strongest practical manner, especially so in the "so-called low water zone," or such seams as may be within 15 inches of the highest part of the crown sheet, measured vertically, the purpose being to keep the welded seams, 78 per cent of which have failed when undue strain was thrown upon them, below that part of the firebox which pulls away from the stays causing pockets or bulges of various depths in cases of low water.

Of the 495 crown sheet failures referred to there were 277 cases where the riveted seams were involved, where 44 or 15.9 per cent of the seams failed, while in 234 or 84.1 per cent of the total riveted seams did not fail.

In the total of 495 crown sheet failures there were 132 cases in which the autogenously welded seams were involved, of which 103 or 78 per cent failed, while 22 per cent did not fail.

During the period July 1, 1915, to April 30, 1924, autogenously welded seams were involved in 26.7 per cent of the total crown sheet failures, while 50.7 per cent of the total fatalities occurred in such accidents where the autogenously welded seams were involved.

It will be seen from this that 15.9 per cent of the riveted seams failed, while 78 per cent of the autogenously welded seams failed under exactly the same conditions. The average number of persons killed per accident in which the riveted seams were involved was 0.76 as compared with an average of 1.17 killed per accident where the autogenously welded seams were involved.

It may be said that a large percentage of the crown sheet failures involved in the discussion were caused by overheating due to low water, therefore, the primary causes of such failures were overheated crown sheets, and that nothing can prevent a crown sheet from coming down when allowed to become extremely overheated, with which I agree. But when a stronger construction of the firebox seams will reduce the number of fatalities and the damage to property, I feel that there can be no excuse to offer for not employing the strongest and best practical methods.

I do not desire to be understood as opposing autogenous welding when properly and discreetly used, and believe that it has a very wide and useful field. If we are to profit by the experiences of others, we must give careful consideration to the result of all practices and methods. The extreme to which autogenous welding has been carried is what I have taken exception to. It is not "a cure-all," nor can it be used indiscriminately with safety, nor even economy.

Cost of Removing Mud Ring Rivets

The most economical method of cutting off and removing mud ring rivets is by the use of the gas torch in turning the rivet heads off, then backing them out in the regular way.

It is well known that some mud ring rivets are easier to remove than others. The hard ones are either drilled out or burnt out of the ring. Sometimes it is found advantageous to heat the mud ring, just above or below the rivets which are hard to back out. This expands the hole and in many cases makes the rivet easier to back out.

The cost of removing mud ring rivets depends upon several conditions. "Cost of gas, which shops buy, while others manufacture." Whether or not the rivets are hard, or easy to back out, as well as the class of labor used in doing the work, and the price per hour paid such labor. However, as a fair estimate would say six cents per rivet plus the cost of gas would be a fair price.

This report was prepared by a committee composed of Charles P. Patrick, chairman; J. P. Malley, M. G. Guiry.

Removing and Renewing Firebox Sheets

Locomotive firebox - repair

The most up-to-date method of removing firebox sheets from a locomotive firebox is by the use of the oxy-acetylene torch and air ram. Rivets also are burned out with electric process in the flange of back flue sheet or door sheets. Cone head rivets can be burned off in mud ring with either electric or acetylene torch and air ram used to punch the rivets out of the ring.

Rigid staybolts that are riveted over at both ends can be drilled on the outer end of bolt or burned out. However, when the acetylene torch is used on this work great care must be taken by the operator to see that no damage is done to the outside boiler sheet.

When fireboxes have a full or partial installation of flexible staybolts and are equipped with caps and sleeves on the outside sheets, these bolts can be burned on the firebox side and driven out entirely free from the sheet. The same methods can be used when removing back flue sheets or door sheets only or applying new side sheets.

The cost of removing fireboxes is very largely dependent on the character of the shop doing the work. One shop may be up-to-date with all the latest appliances while another may be behind in this feature and therefore unable to compete with the up-to-date shop in matters of cost. However, the

advantage in cost is in the matter of methods between the use of electric or acetylene torch as compared with the former method of drilling staybolts and the use of sledge hammers and chisel bars is in favor of the torch, because it is more economical as well as effecting a great saving of time, which is equivalent to money. It assists in keeping to schedule time which is a saving in overhead expense.

Taking up the question, "Is it more economical to renew fireboxes without removing boiler from engine frame?" Having had experience in both ways of applying new fireboxes with boiler removed from the frames and applying new fireboxes without removing boiler from engine frames, two of us are in favor of removing the boiler from the frames whenever there is a new firebox to be applied, nothwithstanding there appears to be an added cost on account of having to remove the cylinder saddle bolts and a few pipes. We believe this cost is offset by the easier way in which the boiler maker can handle the work. The old firebox can be removed in a shorter time. The new firebox can be assembled and fitted together better than it can be when assembled in pieces in the boiler. Also, it does not matter whether the firebox is riveted together or welded together. The matter of cost cannot be entertained when applying new fireboxes to locomotive boilers; the best workmanship is what we want and we don't always know we get that when new fireboxes are applied to boilers that are not removed from the frames.

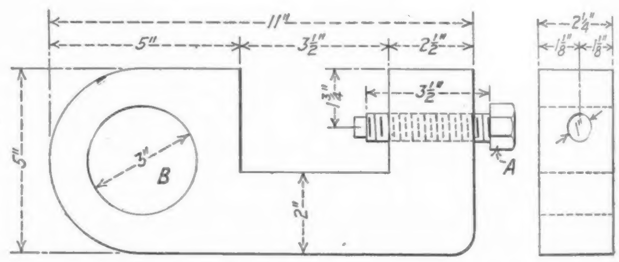
To give an estimated cost of applying new fireboxes to locomotive boilers for all railroad shops it appears to two of us that it cannot be done without doing an injustice to some shops that are not as thoroughly equipped for handling the work as are some of their neighbors. Two of the committee state it is more economical to renew fireboxes without removing the boiler from the frames. The firebox in their case is fitted together on the floor and assembled in the boiler by bolting the plates separately in place in the following order: Crown sheet, side sheets, then door sheet and tube sheet. The door sheet flange is provided with a shorter flange than when riveted and is welded entirely above the foundation ring. The tube sheet flange is treated similarly except where it is riveted in the ordinary way to the crown sheet. The crown sheet is welded to the side sheets. The joint of same is kept about 14 inches below the highest part of crown sheet. A patent welding method is used throughout, which has been employed for over three years, and it has given entire satisfaction without attention or failure. At the least, the cost of removing and replacing the boiler on the frames is saved by this method. One member of this committee quotes a cost of 21 cents per pound for labor and material charges between the incoming test of the boiler and its completed test, figured from the 1923 schedule of rates and material. This includes the store material and overhead, but excludes the shop overhead expense. He also favors a comparison of costs where shops are equally equipped for the performance of the work and claims a longer life for side sheets when the heavier crown sheet does not extend to include the side sheets. One member of committee suggests that it would be better to drive mud ring rivets with air hammer and air jam than to double gun them in order to be better able to remove them when necessary.

This report was prepared by a committee composed of Thomas Lewis, chairman; A. S. Greene, J. T. Johnston, T. W. Lowe.

Crane Lifting Clamp

THE clamp shown in the illustration is useful to mechanics who work on heavy castings such as cylinder saddles, deck castings, etc., which have to be handled by a crane.

The clamp is fastened to the casting by the set screw *A* and lifted by the crane chain hook through the eye *B*. This

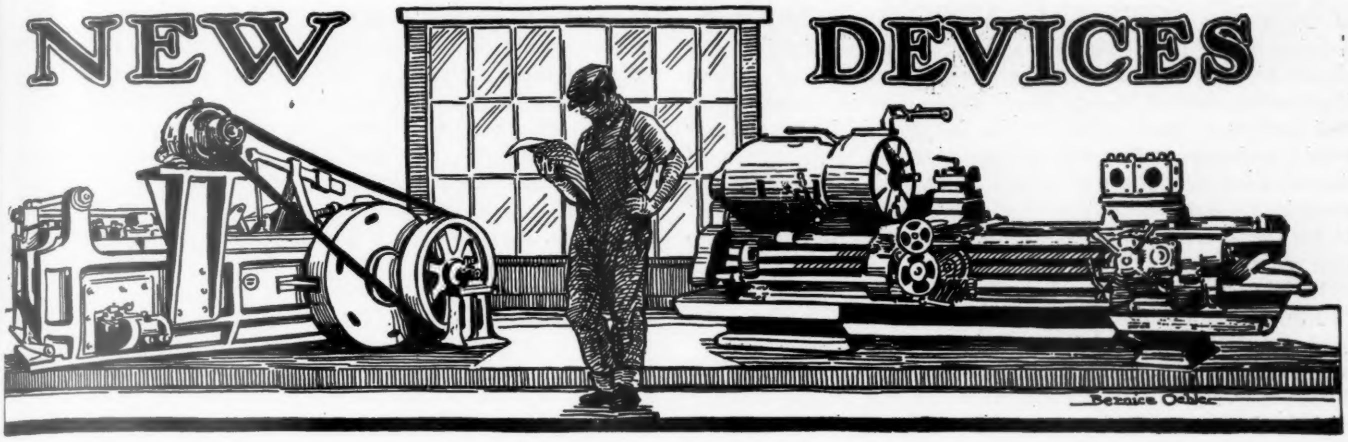


Clamp for Lifting Heavy Locomotive Castings

is much easier and quicker than by wrapping a heavy crane chain around a casting for a lift.

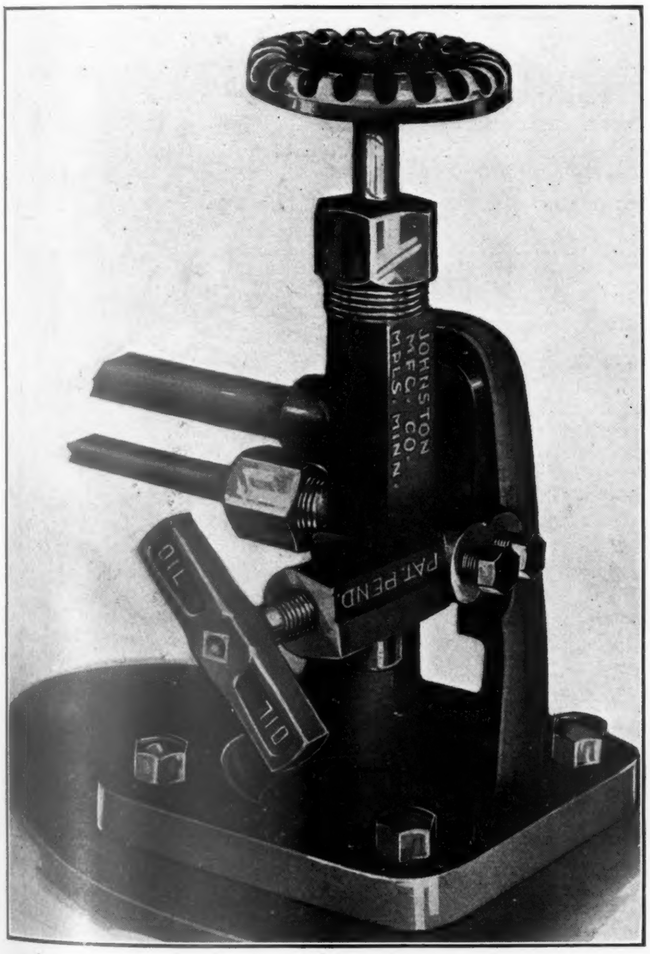
In handling cylinders for machining, this clamp can be fastened to the ribs of the casting so that it is possible to set the casting in practically any desired position.

Illinois Central Yards at Chicago



Non-Clogging Vacuum Oil Burner

A NON-CLOGGING vacuum oil burner which contains no oil valve or small oil passages has recently been designed by the Johnston Manufacturing Company, Minneapolis, Minn. The oil supply to this burner is regulated indirectly by an air valve which rarely clogs and maintains a uniform flow. There is no choke or restriction in the oil passages. This burner operates continuously without variation or clogging on oil containing considerable free carbon and dirt.



Johnson Vacuum Oil Burner Consisting of Only Two Working Parts

The burner has only two working parts. These are the two needle-point air valves, one which regulates the compressed air and the other which indirectly regulates the oil feed. The oil regulating valve is clearly marked and is operated the same way as any other valve. In order to handle very thick oil, the burner has a high vacuum and large

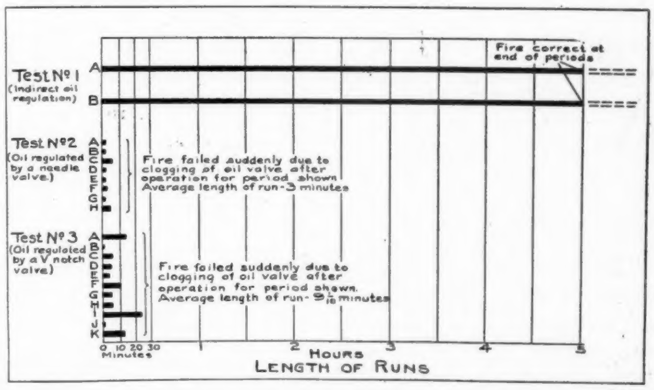


Fig. 1—Lengths of the Various Runs with Each System of Oil Regulation

oil connections. It is designed so that the oil feed automatically increases and decreases with the air pressure and a proper and uniform flame is maintained regardless of large

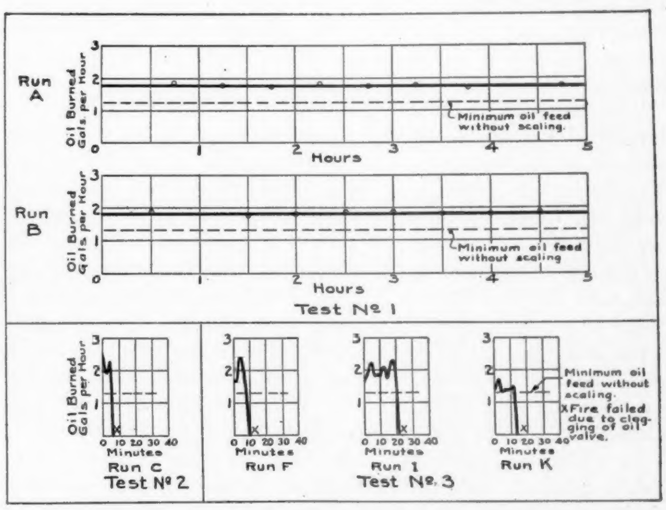


Fig. 2—Rate of Oil Feed in Gallons of Oil Burned Per Hour

variations of pressure in the air lines. The operation of the burner is not affected by wear of the parts.

The Johnston Manufacturing company sponsored at one

of the leading universities a series of tests dealing with the relative merits of oil burners as used on a rivet forge. The object of these tests was to compare the abilities of various kinds of burners to operate on oil which contains considerable sediment and free carbon. The length of time a burner would maintain a fire without attention, or readjustment of the oil feed, and the uniformity of the oil feed and of the gases in the heating chamber during each run, were considered to be the correct measures of the ability of the burner to operate under the given conditions.

In Fig. 1, the lengths of the various runs with each system of oil regulation are shown graphically. The lines for the burner with indirect oil regulation have been shown dotted beyond the end of the five-hour test periods, since this burner was shut down only because the end of the working period of the shop had been reached. In Fig. 2 the rate of oil feed in gallons of oil burned per hour are shown graphically. All curves for the oil feed are plotted to the same vertical and horizontal scales.

The burner with indirect air valve regulation of the oil feed maintained a constant flame without visible evidence of variation during both of the five-hour test runs and would apparently have continued indefinitely without variation. With oil regulation by means of a valve of either the needle or V notch type, the oil feed fluctuated so rapidly that measurements of the amount burned could be obtained for only a few of the longest runs and the flame varied between a smoky and a scaling condition. After operation with valve control for a very short time, the valve clogged and the fire suddenly failed. The fluctuations in the oil feed under valve control were evidently due to the free carbon and sediment partially bridging across the valve opening, then breaking down, and finally bridging over the opening entirely so that the fire failed.

Inasmuch as scale is produced by free oxygen in the gases in the heating chamber, the oil feed should be maintained continuously above the quantity necessary to combine with all the oxygen in the air entering the heating chamber. This quantity for the burner as used in these tests is shown on the charts by the line marked, "Minimum oil feed without scaling." The oil feed was above this line continuously during both tests of the burner with indirect oil regulation. In the case of the burners having direct valve control of the oil feed, the feed fluctuated considerably and then suddenly dropped below this line. The length of these runs with direct valve control of the oil feed was variable, and constant attention would have been necessary to avoid scaling the rivets or creating a smoky condition.

Pratt & Whitney Speed Reducing Face Plate

A SPEED reducing face plate adaptable to its new 16-in. Model B lathe has been placed on the market by the Pratt & Whitney Company, Hartford, Conn. This face plate gives a six to one reduction to whatever spindle speed is engaged, so that extremely low speeds are available when the nature of the work demands them.

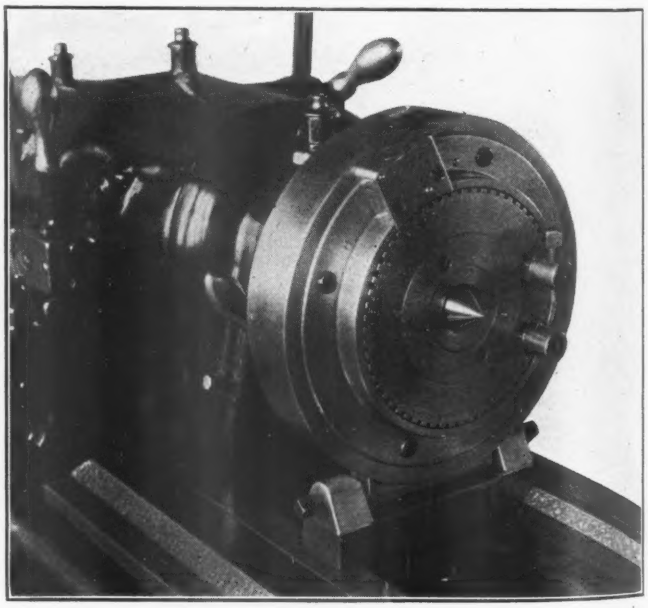
The new attachment takes the general form of a face plate. A gear is attached to the spindle nose. Attached to a plate which carries the driving dog, are two planetary gears which mesh with the spindle gear and a large fixed internal gear which is held from rotating by being clamped to the bed. The plate is thus given its reduced speed.

Owing to the fact that the regular headstock center which is mounted in the spindle nose is used for this attachment, the accuracy obtained with it is the accuracy of the lathe itself. There is no loss of alinement due to extra mechanism being inserted between the lathe spindle and the work center. The simplicity of the whole attachment makes it very easy to operate, and as it may be set up or taken off practically as quickly as a regular face plate, it forms a very convenient solution to some difficult turning problems.

The new attachment has many uses. It has been primarily developed for use in relieving operations of all sorts. This type of work requires a very slow spindle rotation in order that first class work may be accomplished, and as the attachment makes possible speeds as low as two revolutions per minute, the range of relieving work which may be accomplished with it is greatly increased. The relieving attachment for the Model B lathe has been designed in conjunction with the speed reducing face plate so that no additional relieving tables are needed. There are two differently speeded drives provided for the relieving attachment, one for use with the face plate and the other for ordinary relieving without it. Thus the same tables apply in either case.

In addition to its value in relieving, the slow rotation makes possible extremely accurate thread chasing because of the use of the headstock center without any intervening parts. This feature is of particular value in truing up precision screws.

A further use of the speed reducing face plate is the cutting of extremely long leads. There has been no difficulty experienced in cutting leads up to 12 in. on the Model B lathe equipped with this attachment. This opens up a range of work which has hitherto not been considered practical for an engine lathe. Large leads of this sort have been cut with a feed of .002 in. without trouble from chatter marks. The face plate is also designed to be used for accurate indexing. A plate with 60 notches gives every subdivision



Speed Reducing Face Plate Which Gives Speeds as Low as Two Revolutions Per Minute

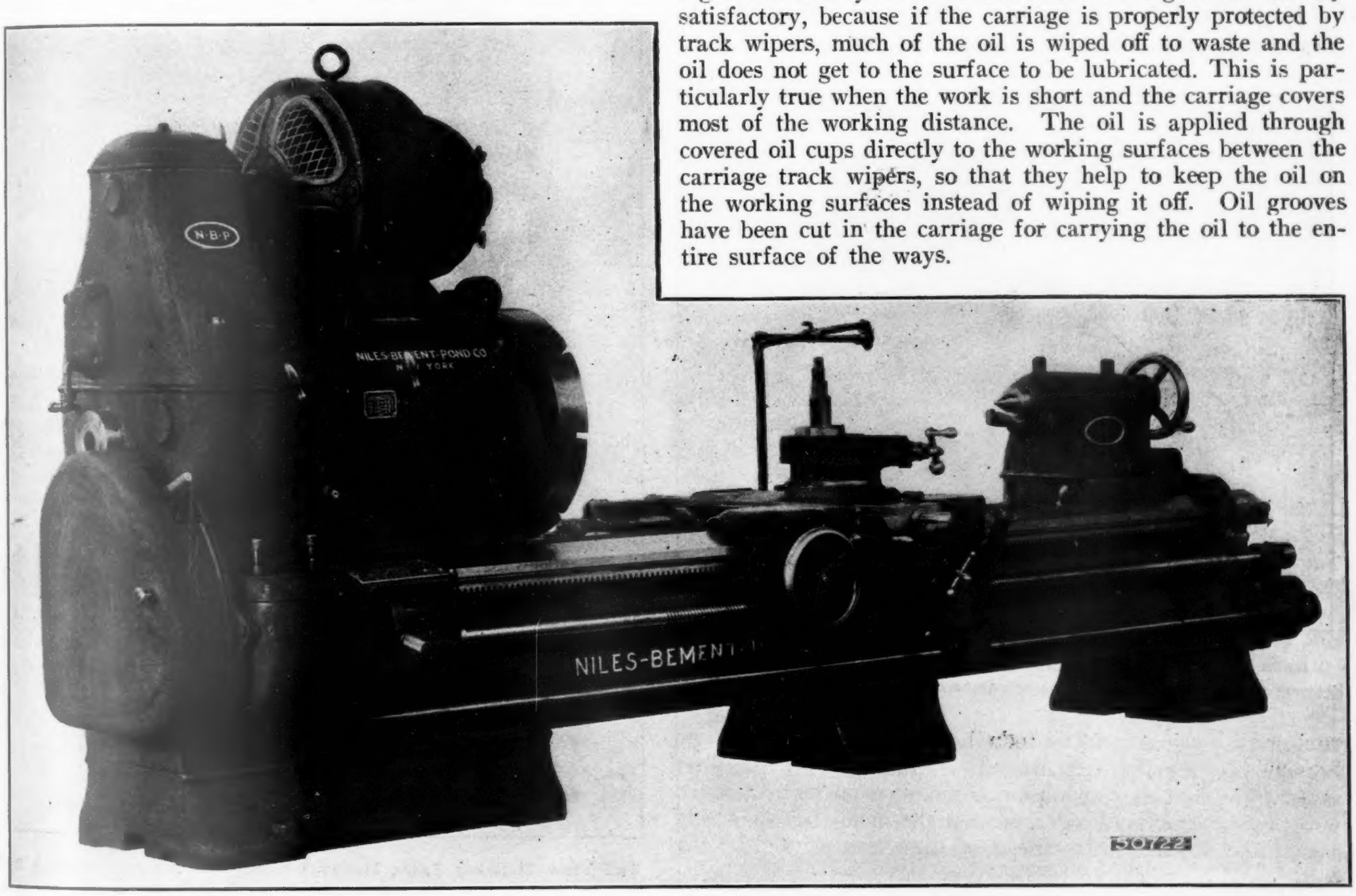
needed for ordinary work requiring multiple starts. A convenient pawl engages the notches as desired, and each notch is numbered so that there is no difficulty in obtaining correct indexing. The indexing feature is particularly valuable for the multiple starts which usually accompany long leads so that this type of problem has been greatly simplified.

If desired, the gearing may be locked so that there is no speed reduction, and the attachment then becomes a regular indexing face plate.

Heavy Duty Lathe Provided with a Rapid Power Traverse Screw

THE primary object of the Niles-Bement Pond Company, New York, in designing the heavy duty lathe, here described, was to put on the market one which has more driving power, more strength and rigidity, greater ease of operation and greater endurance than any machine that this company has yet designed. Some of the salient features which tend to provide rigidity and strength are a bed which is cast with a solid web over the top to tie the two ways together, a carriage running on a heavy rigid tool slide; an apron provided with double walls and cast in one piece and steel gears which are all of the Maag design. The ease of operation is brought about by the rapid power traverse, a direct reading plate for selecting the desired feed, a "Jog" push button provided on the head for turning the motor slowly while shifting gears, and a thin apron which allows the operator to stand close to the work.

The bed of this machine has been designed to stand the stresses induced by the cutting tool without vibration. The



A Niles-Bement-Pond Heavy Duty Lathe Equipped with a "Jog" Push Button Which Controls the Face Plate

front ways of a lathe receive the greatest load from the cutting tool. The design of the machine has provided, in addition to the heavy double cross ties spaced every 24 in., an inclined solid web, which ties the front and back walls rigidly together and gives the front track a particularly strong support. The bed also has an unusually great depth and is supported on heavy cabinet legs. The inclined web also carries the chips through the holes in the back wall of the bed to the chip pan located at the rear of the machine, from which the chips may be easily removed.

The degree of accuracy which a lathe bed will maintain after it has been in service for some time is dependent on several important factors. The bearing pressure per square inch between the carriage and the bed should be as low as possible. The LeBlond type vee, which is used, has approximately twice the usual bearing area, which reduces the bearing pressure per unit of area between the carriage and the bed, and in consequence reduces the amount of wear produced. The bed is made of a special high steel mixture and cast so that a hard, close grained, uniform surface is obtained, which gives excellent, uniform wearing qualities. The ways are protected from being cut by steel chips by two sets of track wipers on the carriage, one ahead of the other, to prevent the scoring of the ways. The first wiper consists of a thin brass plate, which presses lightly against the track at an angle so that the chips are pushed off instead of being wedged under the wiper as in the ordinary construction. The second wiper consists of a heavy felt, which takes up any very small particles which may have slipped by the first wiper.

The old way of lubricating the carriage by merely applying oil to the way on either side of the carriage is not entirely satisfactory, because if the carriage is properly protected by track wipers, much of the oil is wiped off to waste and the oil does not get to the surface to be lubricated. This is particularly true when the work is short and the carriage covers most of the working distance. The oil is applied through covered oil cups directly to the working surfaces between the carriage track wipers, so that they help to keep the oil on the working surfaces instead of wiping it off. Oil grooves have been cut in the carriage for carrying the oil to the entire surface of the ways.

The machine is provided with a rapid power traverse. A separate motor drives a right and left hand screw at the back of the lathe through a gear box in which the gears run in oil. A right and left hand nut rotates on this screw ordinarily inside of a casing bolted to the carriage. When the rapid traverse lever at the front of the carriage is moved, it holds one or the other of the nuts stationary, depending on which direction the operator desires to move the carriage. It is very simple and is out of the way on the back of the lathe.

The apron is cast in one piece and designed so that all the gears have a double bearing. The gears are all of the Maag type and made of heat-treated steel, designed not only for strength but for securing the maximum amount of rolling and the minimum amount of sliding action. Instead of hav-

ing the usual friction feed, this machine has been provided with the positive fine tooth clutches so that the feed can be snapped in and out instantly. This is particularly important when it is desired to stop at a shoulder very accurately. Instead of having two levers, one for the cross feed and the other for the longitudinal feed, it is equipped with a single lever for operating both. Usually the operator will feed only in one direction, so that ordinarily he will need only the one lever for controlling his feed. By putting in most of the gears in the central section of the apron, coming under the rest, it has been possible to make the apron on each side so compact that the operator can get close to his work. Interlocks have been provided so that it is impossible for the operator to engage his lead screw nut while his power feed is on. The single lever for engaging both the longitudinal and the cross feeds also has been provided with a safetv trigger, so that it will be impossible for him to go from cross feed to longitudinal feed accidentally or vice versa. All the gears and the bearings on the apron are lubricated from an oil reservoir, so that the operator may oil the whole apron from a centralized point.

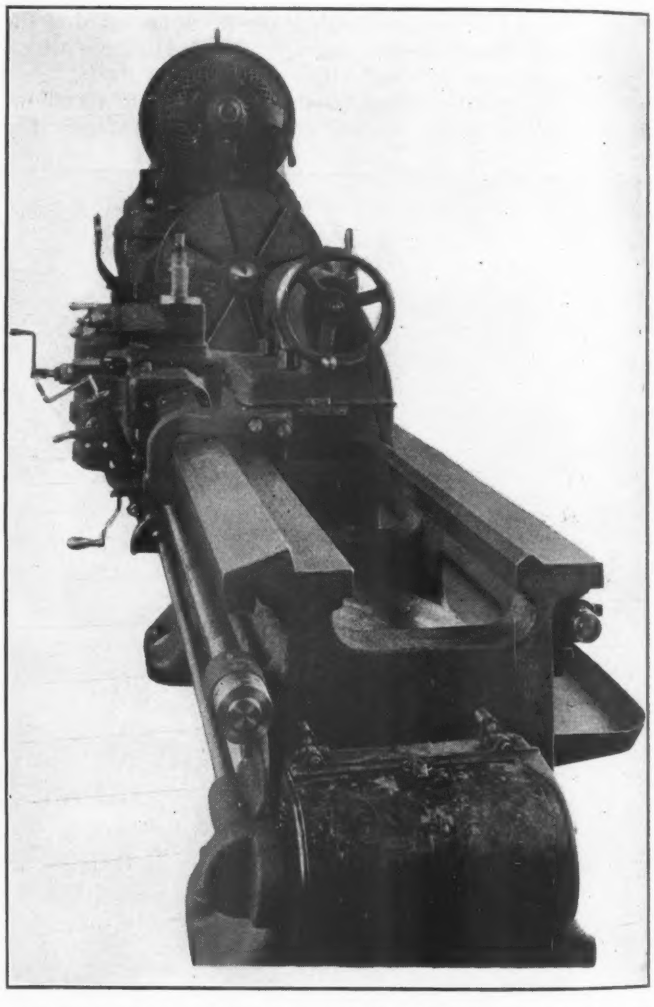
The machine is designed with a powerful drive in an oil-tight headstock. None of the gears are overhung. They are

Back View Showing Rapid Traverse Screw and System of Lubrication

enclosed in a dust- and oil-tight head, and all the gears and bearings are flooded with filtered oil, pumped from the filter tank. The first driving pinion is mounted on its own shaft, with bearings on both sides, so that the motor bearings only carry the armature load instead of the loads induced by the belt and gear as in the other drives.

The d. c. and a. c. motor drive and the belt drive headstocks are all similar in structural principles of design, the only difference being that the a. c. and belt drive heads have more mechanical gear shifts. On the d. c. drive, full advantage is taken of the variable speed motor. The headstock is simplified, and the operator, through the control handle on the carriage, can easily vary the speed, so that it is seldom necessary to leave the carriage to shift gears. When the control handle on the carriage is moved to the "off position," the motor brings the faceplate quickly to rest through the dynamic brake circuit.

On other lathes it is necessary to provide a friction clutch to enable the operator to shift the gears into mesh for the different speeds. This lathe is provided with a "Jog" button control, so that when the button is pressed the gears turn over very slowly so that they may be easily shifted. As soon as the operator takes his finger off the button, the machine stops. This is also a very valuable feature on chucking work when the operator may wish to turn the faceplate through a small angle to adjust the paws. The operator may turn the faceplate through any angle by merely keeping his finger on the button the required length of time. The a. c. motor is direct-connected to the machine, since the need for the friction clutch has been eliminated by the "Jog" button. It may be instantly started or stopped from the control handle on the carriage by means of the automatic controller. A mechanical brake stops the machine instantly when the control handle is placed in the "off" position. If desired, a reversing controller can be furnished at a slight additional cost, so that the operator can also reverse the lathe from the carriage. The construction of the



End View Showing Extra Heavy Ribbed Sections and Sloping Bed Which Directs the Chips Into the Chip Pan on Back of the Lathe

a. c. headstock is similar to the d. c. headstock, except that there are 12 speed changes instead of the four speed changes on the d. c. drive.

The single pulley is mounted between taper roller bearings which are adjustable for wear. The multiple disc clutch is of the type used on automobiles. The discs are engaged by springs, so that the pressure between the discs is not reduced as they wear and no adjustment is necessary to maintain the driving power of the clutch. A large number of steel discs are used, the alternate discs being faced with brake lining. Owing to the number and the size of the discs, the friction area is very large. The pressure between the discs is kept low and wear is reduced to a minimum. The clutch is operated from a handle on the carriage or from a lever below the head, which may be used when

shifting gears. When the clutch is released, a brake is automatically applied, stopping the machine at once. The clutch is operated through a ball thrust bearing. An extra wide driving belt with a high gear ratio gives abundance of power with a low belt tension. Twelve speeds are obtained by shifting gears.

The standard taper attachment travels with the carriage and is therefore always ready for use. The cross-slide is connected to the carriage for straight turning, and to the sliding block when turning tapers, the same bolt being used in each case so as to eliminate the possibility of connecting the taper attachment while the cross-slide is locked. The change from straight to taper turning is made by simply removing a bolt from one place and putting it in another, which may be done from the front of the machine. The long block, which slides in the taper bar, has large bearing surfaces. It is fitted with a taper gib, which is designed to receive and deliver pressure at the same height, which prevents any rocking and results in smooth and accurate work. The bolts which lock the taper bar can be reached from the front. The motion is transmitted through the cross-feed screw which, being of ample size to move the tool rest for straight turning, will move it with equal rigidity when turning tapers. The backlash in the screw is taken up by means of a compensating nut. The taper attachment does not cut down the swing over the bridge. Another advantage is that the cross-feed screw and taper attachment may be used at the same time.

A massive tailstock has been designed to carry heavy loads. It has a long bearing on the bed and is clamped to the bed by four locking bolts, all of which can be conveniently reached from the front of the machine. In the ordinary construction, the tailstock is split and the spindle clamped by drawing the split portion together. This throws the spindle out of alignment more or less and weakens the tailstock. On this tailstock the spindle is rigidly clamped by the double plug locking mechanism, which does not disturb the alignment of the spindle and permits a good bearing between the spindle and the tailstock. The spindle and self-ejecting center are made unusually large so that the heaviest loads can be supported rigidly. A large screw working in a long bearing makes it possible easily to feed the largest drills.

The quick change gear feed mechanism is mounted in a self-contained unit. A direct-reading feedplate has been provided so that the operator may select the desired feed immediately by placing the tumbler in the proper hole. The whole mechanism may be exposed by removing the top cover, making the gears readily accessible. The shafts are large in diameter with a relatively short distance between the supporting bearings.

All of the gears and bearings are continuously flooded with oil from the circulating oil supply furnished by the oil pump through the headstock. The oil from the feedbox overflows and drains into a tank in the bed, where it is filtered and again pumped back into the bearings. The cover on the feedbox projects well beyond the narrow tumbler slot and effectively protects the gears from dirt. The feed gears on the end of the bed are guarded by a strong cast-iron gear guard which is hinged to the bed. This construction is much better than having the type of guard which merely lifts off, since the operator is apt to remove the cover and forget to put it back on.

The lathe is provided with a coolant attachment. The pump for it is driven from the rapid traverse gearbox. It delivers the coolant to the flexible steel hose connected to the lathe carriage. The fluid, after cooling the tool, falls between the ways of the bed and drains through the holes in the back of the bed to the steel pan. From here it is drained to the head-end leg of the lathe, which forms a settling tank. This tank is divided into two compartments, the first compartment acting as a settling chamber for the small particles which pass through the screen. The overflow from this compartment goes to the second compartment from which the pump takes its suction. A clean-out door has been provided from which the sediment may be removed.

Lubrication &c

Cars / Bearings

The Phee Journal Lubricating System

By Lge Je 21 p1753 Same

THE Phee system of journal lubrication, a recent development of the Froedtert Equipment Corporation, Milwaukee, Wis., is now being tested on three important mid-west roads and these tests promise to be of more than ordinary interest in view of the lubrication results obtained.

The construction and operation of the device are clearly shown in the drawing, Fig. 1 and the photograph, Fig. 2. A metal plate resting on the bottom of the journal box sup-

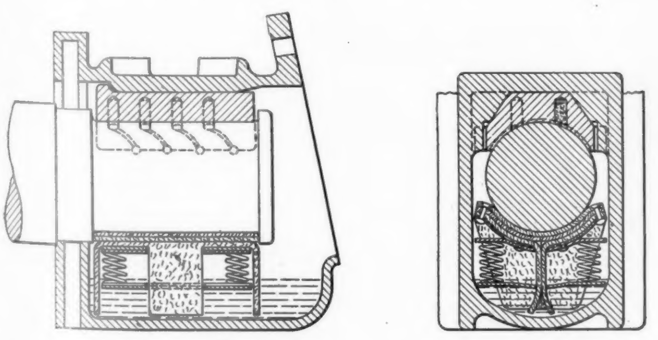


Fig. 1—Sectional Drawing of the Journal and Lubricating Device

ports the upper portion of the device by means of six springs. The upper portion consists of two metal plates supporting three layers of wool felt, 3/8 in. thick. The bottom layer of felt projects at each end sufficiently to drop down to the bottom of the box, and two additional strips of felt project downward to the bottom of the box through the center of the

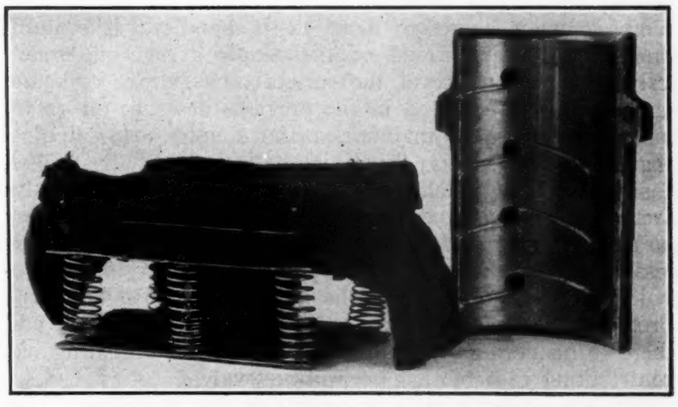


Fig. 2—The Brass Has a Series of Holes Connected by Channels

metal plates. The top two layers of felt are 1 in. shorter than the journal bearing surface to allow for lateral movement. Thus the layers of felt when in position are held in contact with the bearing surface by means of the springs. In addition to this, the brass, which is the standard brass now used, has a series of holes 3/8 in. in diameter and 5/8 in. in

depth, drilled along each side, connected by channels 1/8 in. in depth as shown in Fig. 2.

The installation of this device is said to require no alteration in the construction of the standard journal box as now used. It is simply inserted in place of the oil saturated waste. Before inserting, the spring and felt devices are thoroughly saturated with oil, the same oil now employed being used in conjunction with this method. About two quarts of free oil are added to the box after placing the spring and felt devices in position.

The action of the Phee system in supplying oil to the journal is as follows: Oil is fed to the bearing surface by means of the pad which is in contact with the journal, additional oil being fed as required to the pad by means of the four wicks which rest in the free oil in the bottom of the box. These wicks have a threefold action: They feed oil to the pad, filter the oil as it passes up, and act as a guard at each end, preventing foreign matter from coming in contact with the bearing surface. The purpose of grooving and drilling the brass is mainly to insure a plentiful supply of free oil to the bearing surface during the time required to allow the brass to be worn to a perfect bearing seat.

The following results are reported of a test of 12 of these devices applied March 1, 1924, to a car in passenger service making a run of 190 miles a day. The journals on this car are 4 1/4 in. by 8 in. in size. On April 1 this car was inspected after a total run of 5,980 miles and the spring and felt devices were in excellent condition, the felt showing only slight signs of wear; the running temperature of the journals was lower than on those lubricated by waste and oil, and there was no indication of hot journals. On May 3 this car had made a total run of 11,970 miles with no attention whatever. No additional oil had been added since installing the devices and apparently the car was in condition to run several thousand miles further before it would be necessary to add additional oil. One of the boxes on this car was defective to such extent that it would not hold oil, and the car ran over 5,000 miles with no free oil in the box, sufficient oil being contained in the felt pad to lubricate the journal properly.

The tests up to the present time apparently indicate that a considerable saving in oil and labor can be effected by the use of this method of lubrication. One of the greatest claims, however, is that this system will eliminate the trouble experienced at the present time due to hot boxes, the actual cost of which, while very difficult to estimate in dollars and cents, is of considerable extent when the delay to the train, loss of revenue by setting out the car, labor, loss of material due to destruction of the journal, brass, waste and oil are all considered.

Single Car Testing Device

THE single car testing device illustrated is a recent development made by the Westinghouse Air Brake Company, Wilmerding, Pa., to meet the demand of certain railroads for a device to test the brake on a single car, which design displaces those devices used by many roads, made up of pipe fittings, cut-out cocks and choke fittings. This device is not designed for the purpose of testing triple valves, as it is not the intention to displace in any manner the A. R. A. requirements with respect to triple valve testing on the standard A. R. A. rack.

When a car is on the repair track the brake should be tested, regardless of the last cleaning date, before the car is allowed to go into service, and it is for the purpose of facilitating this test of the general condition of the brake on a single car that the new testing device was designed.

The following advantages as compared to the old style testing device will be apparent from the illustration: It is more compact, therefore more easily handled; it contains one duplex gage instead of two single gages; one rotary valve takes the place of the cut-out cocks, drain cock and chokes which were used in the previous designs; the rotary valve is more easily maintained and simpler to manipulate than the cut-out cocks; the device has a curled hair strainer, easily accessible for cleaning, which protects the rotary valve from dirt and wear; the design is such that the device may be put on the ground in an upright position and is therefore less liable to damage. A handy means of carrying is provided in the handle above the gage, which also acts as a protection to the gage; the rotary valve seats upward and there is no need of a stem gasket, thereby eliminating one contributing cause to a hard working valve.

The operating handle has six working positions. The first position, at the extreme left, is for the purpose of quickly charging the brake pipe and the auxiliary reservoir. The second position admits pressure to the brake pipe at a pre-determined rate and is used to release the brake, after the proper brake application has been made, and determine if the brake is in condition for further service. If the brake does not release under this test, necessary repairs must be made. The third position is lap, in which position all ports are closed. The fourth position is slow application. Should the brake fail to apply during this application, proper repairs must be made before the car is put in service. The

Westinghouse Single Car Testing Device Which Displaces Pipe Fittings, Cut-Out Cocks and Choke Fittings

fifth and sixth positions are for the purpose of determining the stability of the brake in regard to emergency. In the

fifth position emergency should not occur and in the sixth position emergency should take place.

Different sizes of ports in the rotary are necessary for freight and passenger service. The reason is that this device is for testing the brake on a single car; therefore, the volumes on the particular type of car to be tested must be given consideration, and as a passenger car is approximately twice the length of an average freight car, it is necessary to so arrange that the same results are obtained in both cases. These devices are assembled for either freight or passenger service before leaving the factory, and the service for which they are intended is indicated on the name plate. They are so designed that they can be connected to the yard charging line and to the brake pipe on the car.

Standardized Planer Tools

It is a matter of common knowledge that getting the right angle and shape for a planer tool makes a big difference in the results obtained with the tool. The roughing tool that is right for steel will have too keen an edge for cast iron and will tend to dig in, leading to chatter. The first instinct of the operator is to cut down the amount of feed, thereby decreasing production.

There are, of course, certain elementary principles that every planer operator and certainly every foreman should fully understand. The tool ought not to reach beyond the bottom edge of the apron any more than is absolutely necessary, and should be made from heavy stock, so as to minimize springing under the pressure of cutting. At the same time, the right shapes and angles are often a matter of debate, because very few workmen have time to carry through the necessary experiments to establish these shapes and angles, and they certainly must be established by the old-fashioned method of "cut and try."

The G. A. Gray Company, of Cincinnati, Ohio, has recognized this difficulty and has brought out a chart, entitled "Cutting Tools Recommended for Use on Gray Planers." This gives the proper shape as well as the angles of rake and clearances on a set of sixteen general purpose tools, together with sketches showing the use for which the tool is intended.

To supplement the chart, the Gray company furnishes aluminum models, which are numbered to correspond with the chart, and have the various surfaces accurately ground. These can be handed to a blacksmith, who, although he cannot read a drawing, will, in forging a tool, imitate the model so that it can be quickly ground to shape. The set of 16 model tools is mounted on a neat wall board.

G. A. Gray Tool Board Displaying 16 Aluminum Model Tools

Hanaford Angle Cock

The Car Devices Company, Inc., Richmond, Va., have recently added to the line of railway devices an angle cock with a rear extension on the body cast in one piece. The object aimed at in designing this device was to produce an angle cock which would take the place of the old style two or more part malleable iron angle cock holder. This was effected by adding to the body a symmetrical rear extension. A bracket can be applied above or below the brake pipe and riveted to the end sill, or on the side and riveted direct to the striking casting. Best results are obtained by using a 3/8-in. by 4 1/2-in. open hearth steel bracket.

Angle Cock With Rear Extension Cast on the Body

The threads and the end of the nipple on the train line are completely enclosed by the rear extension. This reduces to a minimum loss due to the train pipe nipple breaking through the threads at the angle cock.

Reclaiming Splice Bar Machine—Correction

The June 18 issue of the Daily Railway Age contained a description of a splice bar reclaiming machine manufactured by the Rockford Milling Machine Company, Rockford, Ill. In the last sentence of the article it was stated that the weight of the machine was approximately 1,200 lb., which is an error. The correct weight is between 11,000 lb. and 12,000 lb.

GENERAL NEWS

Electric lights are required in the marker and classification lamps of locomotives in Canada by an order issued by the Board of Railway Commissioners on June 6. The order applies to all new engines that have electric light installations, and to all locomotives after December 31, 1925. This order is made on the basis of a hearing held last February, in which the brotherhoods claimed that oil lamps were not reliable and usually were not well maintained.

The New York State law requiring 24-ft. cabooses and regulating the construction of cabooses, the non-use of small coal cars, etc., is now in effect. The provisions of this law, which originally were put on the statute books in 1913, were later subjected to modifications, postponing the date when they should be enforced, but the last of these modifications has now become of no effect. It appears that substantially all of the railroads affected by the law have complied with its provisions long since.

Big Four Resumes Operation of Shops

The Cleveland, Cincinnati, Chicago & St. Louis has canceled its contract with the Railway Service & Supply Corporation under which that corporation has operated the shops of the railroad at Beech Grove, Ind., during the past two years and is now operating the shops directly. The number of employees now at work is about 900. To those men who were employees of the company under former conditions and who joined the strike of 1922, the road has made an offer to restore seniority rights, under certain conditions, which offer remains good for about one month.

Inspection Bureau Finds 46.9 Per Cent of Locomotives Defective

The Interstate Commerce Commission's monthly report to the President on the condition of railroad equipment shows 5,675 locomotives inspected by the Bureau of Locomotive Inspection during the month of June, of which 2,662 or 46.9 per cent, were found defective and 279 were ordered out of service. The Bureau of Safety inspected 99,722 freight cars, of which 4,207 were found defective, and 1,612 passenger cars, of which 67 were found defective. During the month 18 cases, involving 124 violations of the safety appliance acts, were transmitted to various United States attorneys for prosecution.

Failure of Conspiracy Suit Against the Pennsylvania

The United States Circuit Court of Appeals, at Philadelphia, July 14, dismissed the equity suit brought against the Pennsylvania Railroad by the System Federation of Shop Craftsmen and the Clerks' brotherhood to enforce increases in wages which, as claimed by plaintiff, ought to have been made in compliance with a decision which had been made by the Railroad Labor Board, calling for the continuance of rates of wages which had been paid by the U. S. Railroad administration. The sum named, $15,000,000, was the estimated difference between what the employees have received from the railroad company and what they would have received under the higher rates claimed. The present decision sustains that of the district court, handed down several months ago. Representatives of the shop crafts declare that the case will be appealed to the Supreme Court of the United States.

Wage Statistics for April

The summary of wage statistics for the month of April, 1924, issued by the Interstate Commerce Commission, shows a total of 1,787,217 employees, an increase of 26,949, or 1.5 per cent, over the number reported to March, 1924. Owing to seasonal requirements, an increase of 49,849 employees appears in the maintenance of way group, but this number was offset somewhat by reductions in the maintenance of equipment, and the transportation groups. Notwithstanding an increase of 1.7 cents per hour in the straight time wages of train and engine service employees, which is perhaps the reflection of recent wage adjustments, the average hourly earnings of all employees, owing to an increase in the number of lower paid employees and a reduction in the number of the higher paid employees reported on an hourly basis, shows a decrease of 4 mills per hour. There was also a decrease in the quantity of overtime work and in the average overtime rate per hour. The total compensation in April was 1.9 per cent less than in March. Compared with the returns for the corresponding month last year, the employment in April, 1924, decreased 3.1 per cent and the total compensation shows a decrease of 3.6 per cent.

Cars and Locomotives Placed in Service

Class I railroads during the first six months this year installed in service 70,874 freight cars, according to reports filed by the carriers with the Car Service Division of the American Railway Association. This was a decrease of 8,366 cars as compared with the number installed during the corresponding period in 1923. The railroads on July 1, 1924, had on order 60,315 freight cars as compared with 96,855 on July 1, 1923, or a decrease of 36,540.

The railroads during the first half of 1924 also installed 1,071 locomotives, as compared with 1,998 during the corresponding period the year before, or a decrease of 927. They also had on order on July 1, 360 locomotives, as compared with 1,902 last year.

Of the cars placed in service 12,319 were installed during the month of June, including 4,607 box cars, 3,653 coal cars and 1,976 refrigerator cars, including those installed by railroad owned private refrigerator companies. The railroads also placed in service during the month 160 locomotives. These figures as to freight cars and locomotives placed in service or on order include new, rebuilt and leased equipment.

Progress in Application of B. & O. Shop Plan on C. N. R.

A survey of the main shop points on the Canadian National has been begun, starting with the Winnipeg shops, preparatory to the experimental application of the co-operative shop work plan, known as the Baltimore & Ohio co-operative plan, to the Canadian National Railway System. The plan aims at co-operation between the employees of the shops and the management in the working of the shops with a view to less waste and better production; a voice in shop management for the men; and a share for the employees in the benefits accruing from co-operation. It was endorsed by the convention of Division 4, Railway Employees' Department, of the American Federation of Labor representing all railway shop crafts in Canada. It has also received the approval of Sir Henry Thornton, president of the C. N. R. Following the Division 4 conference B. M. Jewell, president of the Railway Employees' Department of the A. F. of L.; William H. Johnston, president of the International Association of Machinists, and father of the co-operative shop plan; and Capt. O. S. Beyer, Jr., consulting engineer for the shopmen, and representatives of the shop crafts of the system, met Sir Henry Thornton.

Reporting on this conference to officials of Division 4 Mr. Jewell stated, "Sir Henry Thornton said he was convinced that this was the most important gesture that has been made in the industrial world in years and that it has within it the germs of the solution of all our industrial problems. He was prepared to co-operate fully in order to make the experiment a success." After the survey of the Winnipeg shops it was stated at the offices of Division 4 in Montreal that a survey of all the shops in Eastern Canada would be made. A joint report will then be made to Sir Henry by Capt. Beyer and the international unions. The shop for the experiment in co-operation has not yet been selected, but the selection will be made by the shop crafts with the assent of the employees and the management.

C. N. R. Officers Offer to Accept Pay Reduction While Shops Work Part Time

A co-operative plan for assisting the finances of the Canadian National is now in consideration at the headquarters in Montreal. The board of directors has received an offer from the officers of the system, including vice-presidents, general managers, superintendents and heads of all departments and every officer above the grade of chief clerk to have their salaries reduced one day's pay per month during the five-month period of curtailed receipts. If accepted by the board it is stated that the offer would apply only to the period during which a reduction in working hours in the shops of the system is in effect. In the case of Sir Henry Thornton, the president, whose salary is $50,000 a year, the reduction would mean about $1,600.

At the end of June the employees at the Canadian National shops at Point St. Charles (Montreal), St. Malo (Quebec City), Leaside (Toronto), Stratford (Ontario) and London (Ontario) were offered the alternative of a reduction in working hours or a reduction in force. The representatives of the men stated that they would not accept a reduction in working hours under their scheduled agreement with the company, consequently an order was given for the staffs to be reduced on July 1. Then the men from London and Point St. Charles asked the company to reopen the question and they decided they would accept a reduction in working hours to three weeks a month. Leaside and St. Malo did not come to any decision and steps were taken to reduce the staff. The acceptance by Point St. Charles, Stratford and London was for the month of July only, and the men are now taking a canvass as to the ensuing five months. Since then Leaside and St. Malo have asked to go under the scheme of reduction of working hours.

Railroad Wages Hold Their Lead Over Those in Other Industries

Railroad wages continue to lead those of manufacturing industries, according to the National Industrial Conference Board, New York City, which has recently investigated the trends of wages, hours and employment of railway labor as a whole from the 1914 period to the end of the first quarter of this year. In the first quarter of 1924, the average hourly earnings of all railroad wage earners were 60 cents, which is 13 per cent greater than the hourly earnings in 1914, and 10 cents below the highest peak of 1920. The purchasing power of the weekly earnings of these employees in the first quarter of 1924 was 30 per cent greater than in 1914, showing a slight increase since the second half of 1923. This condition is due to a slight increase in earnings and a slight decrease in the cost of living.

These figures are based on the average number of wage earners on those railroads whose annual revenues total one million dollars a year or over. During the first quarter of 1924, the number of wage earners stood at 1,249,873.

The board made a comparison between the trends of wages for skilled labor in foundries and machine shops and that of skilled shop labor on the railroads. In 1914, the average hourly earnings of both were nearly equal, but by 1920 the railroad group had advanced far ahead. In the first quarter of 1924 the earnings of skilled labor in foundries and machine shops were 108 per cent greater than in 1914, but the railroad skilled shop labor at the end of last year were earning 142 per cent above the 1914 to 1915 level and advanced still further to 72.2 cents per hour in the first quarter of this year. The board's report discusses in detail the rates of wages of railroad workers in relation to their different classes of employment and in relation to the cost of living. Incidentally, it shows the hourly earnings of unskilled railroad workers were 130 per cent greater at the end of the first quarter of 1924 than in 1914. It shows also that practically all increases and reductions in railroad wages since the termination of federal control were based on the rulings established by the United States Railroad Administration, and that the wages of the train and engine service employees, therefore, have never risen relatively so high as the wages of other classes of railroad labor.

In general, the board states that railroad labor as a whole and two of its principal sub-divisions—skilled shop and unskilled labor—were materially better off early in 1924 than in 1914. It is also shown that the average working week per employee was considerably shorter and the purchasing power of weekly earnings substantially greater. The position of the train and engine service employees, however, was not so advantageous as that of other classes of railroad labor or of railroad labor regarded as a whole.

MEETINGS AND CONVENTIONS

Third National Exposition of Power and Mechanical Engineering

Over 260 exhibitors have been assigned space at the third national exposition of Power and Mechanical Engineering which will be held in the Grand Central Palace, New York, December 1 to December 6, inclusive. The exposition will, as usual, parallel the meetings of the American Society of Mechanical Engineers and the American Society of Refrigerating Engineers. The A. S. M. E. meeting will be held in the Engineering Societies' build-

LOCOMOTIVES ORDERED, INSTALLED AND RETIRED

Month	Installed during month	Aggregate tractive effort	Retired during month	Aggregate tractive effort	Owned at end of month	Aggregate tractive effort	Building in R. R. Shops
September	384	22,342,517	260	7,191,302	64,720	2,506,469,051	7
October	408	21,665,487	301	7,935,709	64,827	2,520,200,846	15
November	333	19,054,713	282	7,741,395	64,879	2,532,085,380	14
December	333	18,260,423	316	8,738,378	64,896	2,541,607,425	14
Full year 1923	4037*	....	3672	....	.....	....	..
1924							
January	271	15,228,895	178	4,447,721	64,989	2,552,694,953	14
February	214	11,296,088	175	4,906,435	65,029	2,559,519,253	10
March	176	10,457,064	181	6,033,173	64,911	2,560,076,766	7
April	97	4,167,388	112	2,881,385	64,896	2,561,362,769	11
May	153	6,949,353	107	2,600,445	64,942	2,565,706,413	10
June	...	....	...	....	.....	....	..
Total for 5 months	911	....	...	....	.....	....	..
Total for 6 months	701	....	...	....	.....	....	..

Figures as to installations and retirements prepared by Car Service Division, A. R. A., published in form C. S. 56A-1. Figures cover only those roads reporting to the Car Service Division. 'They include equipment received from builders and railroad shops. Figures of installations and retirements alike include also equipment rebuilt to an extent sufficiently so that under the accounting rules it must be retired and entered in the equipment statement as new equipment.

* Corrected figure.

FREIGHT CAR REPAIR SITUATION

Date, 1923	Number freight cars on line	Cars awaiting repairs: Heavy	Light	Total	Per cent of cars awaiting repairs	Month	Cars repaired: Heavy	Light	Total
January 1	2,264,593	164,041	51,970	216,011	9.5				
April 1	2,296,997	154,302	52,010	206,312	9.0				
July 1	2,260,532	146,299	44,112	190,411	8.4	June	121,077	2,451,758	2,572,835
October 1	2,270,840	118,563	32,769	151,332	6.7	September	114,064	2,335,161	2,449,225
November 1	2,263,099	116,084	34,540	150,624	6.6	October	117,254	2,444,118	2,561,372
December 1	2,270,405	116,697	38,929	155,626	6.8	November	104,761	2,214,617	2,319,378
1924									
January 1	2,279,363	118,653	39,522	158,175	6.9	December	87,758	2,073,280	2,161,038
February 1	2,269,230	115.831	45,738	161,569	7.1	January	76,704	2,083,583	2,160,287
March 1	2,262,254	119,505	49,277	168,782	7.5	February	70,056	2,134,781	2,204,837
April 1	2,274,750	125,932	46,815	172,747	7.6	March	77,365	2,213,158	2,290,523
May 1	2,271.638	131,609	47,666	179,275	7.9	April	75,352	2,074,629	2,149,981
June 1	2,280,295	138,536	50,683	189,219	8.3	May	73,646	2,130,284	2,203,930

Railroad associations

ing, 29 West Thirty-ninth street, New York, and the A. S. R. E. meeting will be held in the Hotel Astor, New York. Plans are under way for the American Society of Heating and Ventilating Engineers to have a gathering of local sections during the time of the exposition.

Railway Technical Congress in Berlin

The Association of German Engineers (Verein Deutscher Ingenieure) in close association with the German State Railways will hold a railway technical congress in Berlin on September 22-27 for the discussion of engineering, mechanical and electrical problems and developments. Extensive exhibits of rolling stock and appliances will be on view. Further details may be obtained by addressing the Verein Deutscher Ingenieure. (Abt. E. T.) Sommerstrasse 4a, Berlin, N. W. 7, Germany.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

American Railroad Association, Division V.—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago.

Division V.—Equipment Painting Division.—V. R. Hawthorne, Chicago.

Division VI.—Purchases and Stores.—W. J. Farrell, 30 Vesey St., New York.

American Railway Tool Foremen's Association.—J. A. Duca, tool foreman, C. R. I. & P., Shawnee, Okla. Annual convention September 3, 4 and 5, Hotel Sherman, Chicago.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, A. F. Stuebing, 23 West Forty-third St., New York.

American Society for Steel Treating.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio. Next meeting September 22-26, inclusive, at Boston, Mass.

American Society for Testing Materials.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting October 20-24, Hotel La Salle, Chicago.

Canadian Railway Club—C. R. Crook, 129 Sharron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

Car Foremen's Association of St. Louis.—R. E. Giger, 721 North 23rd street, E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings second Thursday, January to November. Interim meetings second Thursday, February, April, June, Hotel Statler, Buffalo, N. Y.

Chief Interchange Car Inspectors' and Car Foremen's Association.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago. Annual meeting Hotel Sherman, Chicago, September 23, 24 and 25.

Cincinnati Railway Club.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November.

Cleveland Steam Railway Club.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month at Hotel Cleveland, Public Square, Cleveland.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next meeting Hotel Sherman, Chicago, August 19, 20, 21.

International Railway Fuel Association.—J. B. Hutchinson, 6000 Michigan Ave., Chicago, Ill.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabash St., Winona, Minn. Annual convention September 9 to 12. Hotel Sherman, Chicago.

Master Boilermakers' Association.—Harry D. Vought, 26 Cortlandt St., New York, N. Y.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meetings second Tuesday in month, except June, July, August and September, Copley-Plaza Hotel, Boston, Mass.

New York Railroad Club.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday of each month except June, July and August at 29 West Thirty-ninth St., New York.

Niagara Frontier Car Men's Association.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y. Regular meetings January, March, May, September and October.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings second Thursday in month, alternately in San Francisco and Oakland, Cal.

Railway Club of Greenville.—G. Charles Hoey, 27 Plum St., Greenville, Pa. Meetings last Friday of each month, except June, July and August.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh, Pa.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings second Friday in month, except June, July and August.

Southeastern Carmen's Interchange Association.—J. E. Rubley, Southern railway shops, Atlanta, Ga.

Traveling Engineers' Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting Hotel Sherman, Chicago. September 16, 17, 18 and 19.

Western Railway Club.—Bruce V. Crandall, 605 North Michigan Ave., Chicago. Meetings third Monday in each month, except June, July and August.

SUPPLY TRADE NOTES

The Truscon Steel Company has moved its Chicago office to 165 E. Erie street.

A. W. Dorsch, field superintendent of S. F. Bowser & Co., with headquarters at Ft. Wayne, Ind., has resigned to engage in other work.

The Barco Manufacturing Company of Canada has moved into larger space in the Tower building, Devonshire Road, Walkerville, Ont.

John W. Fogg, general sales manager of the Boss Nut division of the American Bolt Corporation, has been promoted to assistant to the vice-president.

The Gibb Instrument Company, Bay City, Mich., has placed W. F. Hebard & Company, 551 W. Van Buren street, Chicago, in charge of its office in that city.

F. M. English, who has been in the service of the Reading Iron Company, Reading, Pa., since 1919, has been appointed assistant sales manager to succeed A. F. McClintock, resigned.

B. W. Beyer, Jr., sales engineer of the Union Special Machine Company, Chicago, has been appointed district sales engineer of the Industrial Works, Bay City, Mich., with headquarters at New York.

The Thermal Efficiency Company, Scarritt building, Kansas City, Mo., has been appointed district representative in western Missouri and Kansas for the Conveyors Corporation of America, Chicago.

J. W. Selzer, representative of the M. L. Shepard Lumber Company, with headquarters at Chicago, has been appointed representative of J. E. Morris Company, Chicago, with headquarters at Chicago.

C. A. Fisher has been appointed district representative of the Central Iron & Steel Company, Pittsburgh, Pa., with offices at 303 Keystone building, Houston, Tex., and 1918 W. T. Wagoner building, Fort Worth.

The Grip Nut Company, Chicago, has acquired a tract of land at 5917 S. Western avenue, on which it will lay out an 18-hole practice golf course covering two acres, which may be used by employees and visitors to the factory.

J. V. Miller has resigned as district storekeeper of the Chicago, Milwaukee & St. Paul at Deer Lodge, Montana, to become western sales representative of the Prime Manufacturing Company, with headquarters at Milwaukee, Wis.

Benjamin G. Lamme, chief engineer of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., and a well-known electrical genius and inventor, died on July 8 at East Liberty, Pa., after an illness of several months.

The Northern Refrigerator Car Company, Cudahy, Wis., has given a general contract to the Worden-Allen Company, Milwaukee, Wis., for the construction of a one-story brick and steel car construction and service shop, 125 ft. by 225 ft.

D. R. Arnold, general sales manager of the Canadian Car & Foundry Company, Ltd., with headquarters at Montreal, Que., has been appointed assistant to the vice-president of the Union Metal Products Company, with headquarters at Chicago.

W. M. Ryan, of Chicago, Ill., formerly president of the Ryan Car Company, has been elected president and a member of the board of directors of the Youngstown Steel Car Company, Niles, Ohio. Mr. Ryan succeeds William Wilkoff, who remains a member of the board of directors, but who is retiring from active business duties.

The Smith-Heylandt Company has been organized with a working capital of $500,000 and offices at 2633 Fourth street S. E., Minneapolis, Minn. This company will take over the patents, importation, sale and distribution of the Heylandt apparatus for the manufacture of oxygen and other gases by the liquefaction process. E. H. Smith, president of Smith's Inventions, Incorporated, and the Commercial Gas Company, Minneapolis, is president of the new organization; J. R. R. Miles is secretary.

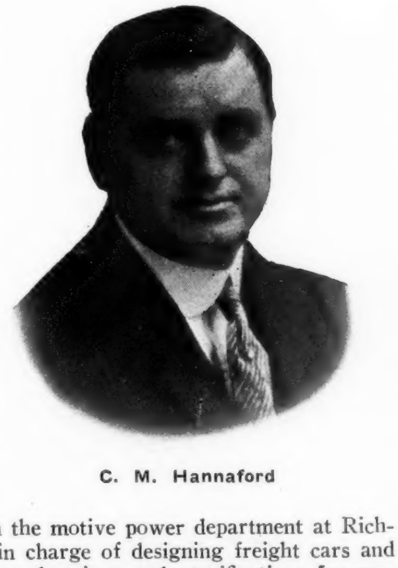
H. A. Irwin, far east representative of the Landis Machine Company, the Landis Tool Company, the Warner & Swasey Company, and the Kearney & Trecker Company, died in Tokio, Japan, on June 22. Mr. Irwin was for a number of years direct representative of the Landis Tool Company in Europe. About four years ago he became connected with the four companies by whom he was employed at the time of his death.

The Bassick-Alemite Corporation, Chicago, has purchased the Allyne-Zerk Company, Cleveland, O., manufacturer of high pressure lubricating systems, and will operate it as an independent unit but under the same general management as the other seven companies controlled by the corporation. E. W. Bassick, president of the corporation, is chairman of the executive committee which directs the corporation. E. S. Evans, president of E. S. Evans & Co., Detroit, has been made vice-president and general sales manager of the corporation and will have charge of the sales of all the units.

William S. Boyce has been promoted to assistant to the president of the Railroad Supply Company, Chicago, in charge of sales. Mr. Boyce was born in Del Rio, Tex. He graduated from the Agricultural and Mining College of Texas with the degree of civil engineer, and entered the maintenance department of the National Railways of Mexico immediately following. In 1909 he returned to the United States to enter the employ of the Chicago Great Western in the maintenance of way department in the office of the general manager and later was appointed roadmaster. Later he resigned to enter the employ of the Atchison, Topeka & Santa Fe as a roadmaster and in 1911 he entered the railway supply field. In 1923 he became associated with the Railroad Supply Company as a special representative, with headquarters at Chicago, which position he has held until his recent appointment.

Official announcement has been made that the British government, through the Surplus Stores and Liquidation Department in London, has accepted the tender of the Montreal firm of Hope E. Scott & Company, Ltd., on approximately 47,000 tons of unassembled freight car materials which were manufactured during the war by Canadian car builders, including the Canadian Car & Foundry Company and the Eastern Car Company, for the Russian government. Through the failure of the Russian government to take delivery of the cars at the time, the materials have been lying in storage at different points in Canada since 1917, but principally at Vancouver. It is the intention of the Scott firm to rebuild the cars for export to Japan. The transaction involves the reconditioning of approximately 4,000 cars. The re-sale value of the cars after reconditioning will be about $6,000,000. Work will begin on them in about a month.

Cleon M. Hannaford on July 1, severed his connections with the Chesapeake & Ohio and will devote his entire time in future to the railway supply business as president of the Car Devices Company, Inc., Richmond, Va., which he organized in 1922 and to the development of a number of patented devices invented by him. Mr. Hannaford entered the service of the Boston & Albany in 1912 as blue print operator, he subsequently was promoted to tracer in the mechanical department, and later served as draftsman until 1916 when he was appointed draftsman in the West Springfield shops in charge of stationary and operating tests. In January, 1917, he left the service of the Boston & Albany to go to the Chesapeake & Ohio as assistant chief draftsman in the motive power department at Richmond, Va., where he was in charge of designing freight cars and locomotives and of preparing drawings and specifications for new equipment. His inventions include a lock lift; forged steel uncoupling attachment; one-piece drop forged angle cock holder; and an angle cock with rear extension.



C. M. Hannaford

TRADE PUBLICATIONS

Pipe Hangers.—An 8-page bulletin, No. 2058, descriptive of Wedgtite pipe hangers, has been issued by the Crouse-Hinds Company, Syracuse, N. Y.

Walworth Log.—The Walworth Manufacturing Company, Boston, Mass., is preparing in booklet form an interesting log of its new branch office at Buffalo, N. Y.

Speed Meters.—A four-page bulletin, No. 624, descriptive of multiple speed meters for power plants has been issued by the Esterline-Angus Company, Indianapolis, Ind.

Connectors.—Male, female and flanged connectors of the CG series are briefly described in an illustrated folder recently issued by the Crouse-Hinds Company, Syracuse, N. Y.

Waterproofing.—Service Bulletin No. 6A briefly describing Karnak waterproofing and listing a number of Karnak publications, has been issued by Gardiner & Lewis, Inc., New York.

Electric Blowers.—Specifications for variable speed electric blowers with new enclosed regulators are given in a bulletin recently issued by the Buffalo Forge Company, Buffalo, N. Y.

Journal Box Lids.—The Allegheny Steel Company, Brackenridge, Pa., has recently issued a four-page bulletin, which is the first of a series to be published illustrating its self-fitting torsion spring A. R. A. standard journal box lid.

Oxy-Acetylene Equipment.—Oxy-Acetylene equipment for welding, cutting, brazing, lead burning, heating and decarbonizing is fully described and illustrated in a 48-page brochure recently issued by the Oxweld Acetylene Company, Long Island City, N. Y.

Engineering Data.—Considerable engineering data regarding the Maxi-mill in railroad work, the Bullard driving box borer and facer and the vertical turret lathe is contained in a loose-leaf booklet recently issued by the Bullard Machine Tool Company, Bridgeport, Conn.

Reamers.—Catalog No. 5 recently issued by the Wayne Tool Manufacturing Company, Waynesboro, Pa., contains in 20 pages a description of the complete line of Wayne bridge reamers, high speed steel counter-sunks and the Wayne drill chuck for salvaging broken twist drills.

Mechanical Painting.—The MetaLayer Schoop process of mechanical painting as it has been developed and perfected for application to any commercial metals, either in wire or dust form, is fully described in a 16-page, illustrated pamphlet just issued by the Metals Coating Company of America, Philadelphia, Pa.

Power Transmission.—A complete text book on power transmission (silent chain transmission in particular) has just been issued by the Ramsey Chain Company, Albany, N. Y. It is a 48-page illustrated book in two colors, and treats on the comparisons between the various methods of drives, leather and rubber belting, gearing, direct drives, and silent chain. It also covers the transmission problems in various fields, and contains complete engineering information and data for laying out silent chain drives.

Locomotive Feed Water Heaters.—Detailed instructions covering the inspection, testing, cleaning and repair of the Elesco feed water heater are given in the second edition of an instruction book recently issued by the Superheater Company, New York. The principle of operation of the superheater also is described and, by means of two colored charts, the passage of steam and water through the equipment is shown. An added feature of this edition of the instruction book is an order list covering feed water heater parts.

Manganese Steel Castings.—The American Manganese Steel Company has issued catalog No. 3 describing and illustrating manganese steel castings used in contractors' equipment. Under this heading is included: Complete dippers for steam shovels, teeth and other parts of such dippers, dredge buckets, wearing parts for gyratory, jaw and roll crushers, screens for quarry and mine operations, conveyor and power chains, elevating buckets, sprockets, gears and pinions. Unusual pains have been taken to present the matter in a lucid form and a large number of illustrations have been used.

PERSONAL MENTION

General

WILLIAM O. FORMAN, assistant mechanical superintendent, with headquarters at Boston, has been promoted to mechanical superintendent, with the same headquarters, succeeding C. H. Wiggin.

CHARLES H. WIGGIN, mechanical superintendent of the Boston & Maine, with headquarters at Boston, Mass., who had completed 42 years of service with the company on July 1, and having requested that he be assigned to less arduous duties, has accordingly been appointed consulting mechanical engineer, with the same headquarters.

EDWIN B. DE VILBISS, whose promotion to superintendent of motive power of the Central Pennsylvania division, Eastern region of the Pennsylvania, with headquarters at Williamsport, Pa., was announced in the July *Railway Mechanical Engineer*, was born on September 13, 1884, at Ft. Wayne, Ind., and was graduated from Purdue University in 1908. He entered railway service on July 1 of the same year as special apprentice of the Pennsylvania in the Ft. Wayne shops and in January, 1911, he was promoted to motive power inspector. On April 1, 1912, he became electrical engineer of the Northwest system and on June 1, 1915, he was appointed assistant engineer of motive power of the Central system. He was appointed assistant engineer of motive power in the office of the general superintendent of motive power on October 15, 1917, and on March 1, 1920, Mr. De Vilbiss was promoted to superintendent of motive power of the Eastern Ohio division, with headquarters at Pittsburgh, Pa. A year later he became master mechanic of the Eastern division, with headquarters at Canton, Ohio, the position he held at the time of his recent promotion to superintendent of motive power.

Car Department

J. T. ST. CLAIR has been promoted to engineer of car construction of the Atchison, Topeka & Santa Fe, with headquarters at Chicago, succeeding E. Posson who has retired. Mr. St. Clair was born in Michigan and graduated from the Engineering department of the University of Michigan, with degrees in both mechanical and electrical engineering. He entered the employ of the American Car & Foundry Company in 1899, and after several years in their shops, was promoted to consulting engineer, with headquarters at St. Louis, Mo. In addition to his duties in connection with the design and construction of cars, Mr. St. Clair was also engaged in the lay-out of car shops and their equipment and the testing of machinery installed. During the war he was a captain in the Engineering division of the Ordnance department in charge of the design and construction of railway mounts for heavy artillery. Mr. St. Clair entered railway service in 1923 as acting engineer of car construction of the Atchison, Topeka & Santa Fe, with headquarters at Chicago, and he remained in that position until his recent promotion to engineer of car construction.

J. T. St. Clair

EDWARD T. MILLAR, who has been on leave of absence on account of illness, has resumed his duties as general car inspector of the Boston & Maine, with headquarters at Boston, Mass.

S. P. ALQUIST, master car builder of the Pere Marquette, has been appointed to a similar position on the Delaware, Lackawanna & Western, with headquarters at Scranton, Pa., succeeding J. C. Fritts, resigned.

Master Mechanics and Road Foreman

G. S. WEST, general foreman of the Cumberland Valley division of the Pennsylvania, has been appointed assistant master mechanic of the Meadow shops, New York division, succeeding J. A. Sheedy, promoted.

Shop and Enginehouse

D. K. CHASE, motive power inspector of the Meadow shops, New York division, of the Pennsylvania, has been appointed general foreman of the Cumberland Valley division, succeeding G. S. West.

P. A. CARTER, foreman of the Chouteau avenue shops of the St. Louis-San Francisco at St. Louis, Mo., has been promoted to roundhouse foreman of the new shops at Lindenwood, a suburb of St. Louis.

W. J. FICKE, formerly night general foreman of the North Side shops of the St. Louis-San Francisco, at Springfield, Mo., has been promoted to general foreman of the new shops at Lindenwood, a suburb of St. Louis, Mo.

Purchasing and Stores

FRANK T. SWAIN has been appointed assistant purchasing agent of the Lehigh & New England.

L. CRASSWELLER, assistant purchasing agent of the Northern Pacific, with headquarters at Seattle, Wash., has been transferred to St. Paul., Minn.

PAUL MCKAY has been appointed assistant purchasing agent of the Northern Pacific with headquarters at Seattle, Washington, succeeding L. Crassweller.

ED HOFFMAN, assistant purchasing agent of the Minneapolis & St. Louis, with headquarters at Minneapolis, Minn., has been promoted to general purchasing agent, succeeding J. D. McCarthy, resigned.

W. B. GORDON, district storekeeper of the Canadian National with headquarters at Montreal, has been promoted to assistant general storekeeper, with headquarters at Toronto, Ont., succeeding Mr. Toye.

E. D. TOYE, assistant general storekeeper of the Central region of the Canadian National, with headquarters at Toronto, Ont., has been promoted to general storekeeper, with the same headquarters, succeeding E. J. McVeigh.

J. R. BENNINGTON, assistant purchasing agent of the Lehigh & New England, with headquarters at Philadelphia, Pa., has been promoted to purchasing agent, with the same headquarters, succeeding E. Hughes, who has resigned.

E. J. MCVEIGH, general storekeeper of the Central region of the Canadian National, with headquarters at Toronto, Ont., has been appointed superintendent of reclamation and scrap, with headquarters at Montreal, Que., a newly created position.

R. J. ELLIOTT, purchasing agent of the Northern Pacific, with headquarters at St. Paul, Minn., has been placed in charge of the purchasing and stores department to succeed F. G. Prest, director of purchases, who has retired under the pension rules after 44 years of continuous service with this company.

A Locomotive of Civil War Days